Mineralogical and Geochemical Analysis of Strontium and Barium Sources in the Point Pleasant Formation

Senior Research Thesis

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By

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TABLE OF CONTENTS

ABSTRACT

Analysis of trace elements in rocks from the Utica-Point Pleasant gas shale play is important because elevated concentrations of trace elements in flowback fluids derived from hydraulic fracturing may be an environmental hazard. Previous reports show high levels of barium and strontium associated with flowback fluids, with no clear explanation as to their origin. The goal of this study is to determine potential sources of Sr and Ba from Utica-Point Pleasant mudrocks that could be released into hydraulic fracturing fluids with which they interact. Polished sections of core were analyzed to determine the concentrations and distribution of trace elements across selected mineralogical/textural regions of the samples.

Samples provided by Chesapeake Energy were observed with light and scanning electron microscopy (SEM) to identify areas of interest for analysis by inductively coupled plasma mass spectrometry laser ablation (ICP-MS-LA). SEM backscattered electron images and QEMSCAN mineral mapping helped determine the spatial distribution of the sulfide, sulfate, and carbonate minerals of interest. Energy dispersive spectroscopy was used to obtain semi-quantitative spot chemical analyses of minerals. SEM images show significant quantities of carbonates ($CaCO_3$), barite ($BaSO_4$) and celestite ($SrSO_4$) which may be the sources of high levels of Ba and Sr in flowback fluids previously reported.

Analysis from ICP-MS-LA line profiles across a pyrite/carbonate mineral assemblage and surrounding silt and clay-size carbonate/silicate matrix show major elements Mg, Ca, Sr, Ba, Al, Na, Ti, Fe, S, Si and trace elements Mo, Mn, Ni, Zn, La, Ce, U, Th, Rb. Barium concentrations were low in the pyrite and carbonate shells but ranged from 50 to 500 ppm in aluminosilicate clays in the matrix and up to 500,000 ppm in barite. Strontium concentrations ranged from 100 to 500 ppm in the pyrite but range 4000-6000 ppm in the carbonate shells and finer-grained clay-carbonate matrix.

ACKNOWLEDGEMENTS

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LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

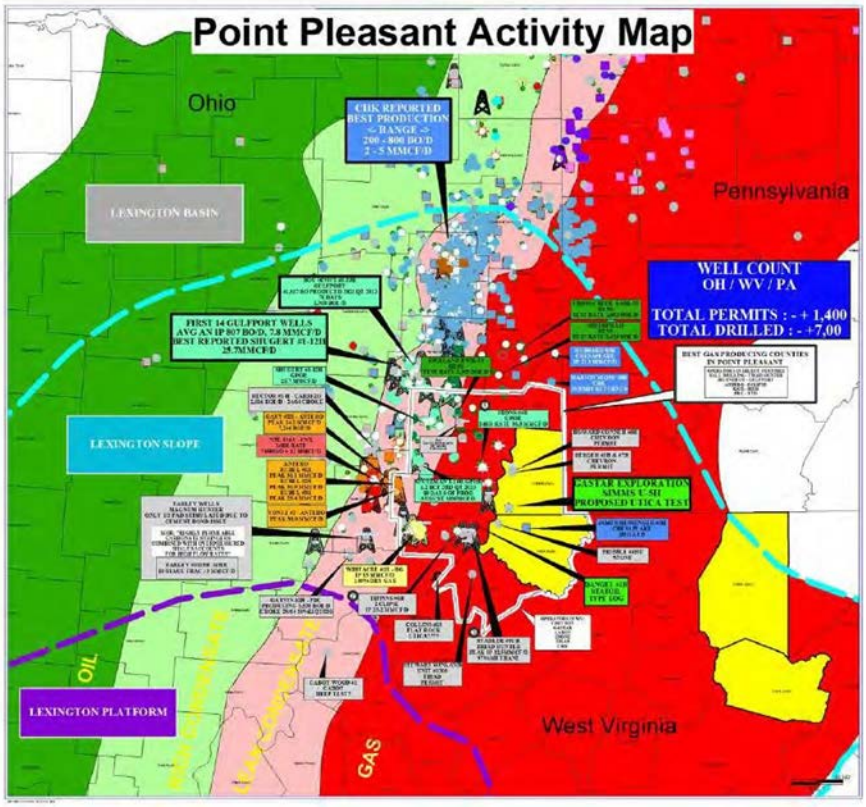
Since the shale gas boom began, there has been immense concern about the fluids and chemicals associated with hydraulic fracturing. Flowback water is defined as water that has returned to the surface when pressure is released on a hydraulically fractured well. Most of the flowback water returns to the surface within the first few days to weeks after the wells are hydraulically fractured. The remainder of the returns overtime during the production phase, when hydrocarbons are extracted from the wellsite. The water quality of the flowback waters can be affected by the chemistry of fluids in contact with the formation, fluids within the formation water, the formation itself, the amount of time the fluid was retained in the well, and the initial quality of the fluids used in the process (Vazquez et al., 2014). Although the interactions with dissolved substances in the subsurface is still being studied, it is important to note that when flowback waters return to the surface, an immense amount of water-rock interaction has taken place. These interactions have the potential to mobilize many different types of chemical compounds, which is why understanding the trace element composition of the Utica/Point Pleasant formation is important.

Monitoring of trace element concentrations has been used to assess the potential environmental impact of flowback water and design strategies for how to process and dispose of the fluids. Trace elements are defined as elements with concentrations less than 0.1% in the Earth's crust (Harris et al., 2013). They are utilized to identify associations among trace elements themselves, and to identify paleoceanographic conditions and depositional processes (Harris et al., 2013). They can also be used to investigate the composition of the fluids associated with gas shale systems and detect substances potentially harmful to human health and the environment. The trace element composition of the Utica/Point Pleasant formations are of particular interest because these organic carbon rich formations are a major source of hydrocarbons. Previous studies have examined flowback waters to measure trace elements compositions and have shown high concentrations of total dissolved salts (TDS), Cl, Br, Na, Ca, Sr, Ba, Ra, and other elements. The levels of TDS, Cl and other elements are as much as 5-10 times the concentration of seawater (Haluszczak et al., 2013). Concentrations of ^{226}Ra, ^{228}Ra, and Ba have been found to be significantly higher than what is allowed for drinking water limits (Haluszczak et al., 2013).

Flowback waters from wellsites located in or near the Appalachian Basin have been shown to contain elevated levels of barium and strontium levels as high as 3g/L (Rozell and Reaven, 2012). The levels deviate from normal water near wellsites which have Sr/Ca ratios of about 1/100 mg/L and Sr/Mg ratios of about 1/50 mg/L for water (Rozell and Reaven, 2012). Barium in high concentrations is poisonous to humans and other lifeforms. It has required standards in drinking water because high levels have been associated with gastroenteritis and muscular paralysis (Kravchenko et al., 2014). In barite, radium, which is harmful to humans, can incorporate itself into the crystal (Dresel and Rose, 2010). Barium is likely to be found in the form of barite a reasonably insoluble sulfate mineral and from contamination with salts associated with hydraulic fracturing (Dresel and Rose, 2010). Strontium is commonly found in the minerals celestite ($SrSO_4$) as an endmember of the barite-celestite solid solution series and strontianite ($SrCO_3$) as an endmember of the aragonite ($CaCO_3$) group. Strontium also can precipitate as celestite with sulfate like barium from hydraulic fracturing fluids (Dresel and Rose, 2010). Elevated levels of strontium although unusual, are not harmful to humans unless strontium is in the form of ^{90}Sr. This isotope of strontium is a fission product of ^{237}Pb linked to nuclear reactions and not involved with the drilling process.

However, the high mobility and presence of strontium is still of interest to scientists because it has potential application as a tracer and source rock indicator (continental vs oceanic).

Like in the Appalachian Basin, Ohio has a high concentration of oil and gas wells located in the eastern part of the state (Figure 1). The trace element concentration of the flowback water associated with hydraulic fracturing and local groundwater wells need to be monitored. The purpose of this study is to determine concentrations and distribution of Ba and Sr levels across selected mineralogical and textural regions of an organic rich sample. The objective is to determine whether these elements originated in the formation itself or from the muds or fluids associated with hydraulic fracturing.



<u>Figure 1:</u> Map of oil and gas production wells in the Utica/Point Pleasant formations with the oil, wet gas, and dry gas windows outlined (Figure from Hammes, 2015)

GEOLOGIC SETTING

The Point Pleasant formation formed during the Middle Ordovician when much of what is now the Ohio Valley was covered by a shallow and expansive epeiric sea. The rocks that represent this formation can be described as carbonate sediments that were deposited in a shallow platform with some shale indicative of an influx of silliclastic sediment (Drozd and Cole, 1994). The formation exists between two carbonate platforms: The Trenton Platform to the northeast and Lexington platform to the southwest. Both platforms are suggestive of deposition in a subtidal environment that was oxygenated (Drozd and Cole, 1994).

The transition between two carbonate dominated platform systems to a clastic dominated system suggest that there was a collapse of a widespread carbonate platform. The lower gradational contact of the Trenton/Lexington Limestone through Utica Shale create a transgressive systems tract (TST) (McClain, 2012). The TST occurs because of a rapid sea level rise overcoming the rate of sedimentation to produce retrogradational onlapping or patterns where rock facies are more distal when traced upward vertically. The thickness of the unit varies from 40 feet to over 100 feet (Wickstrom, 2013). Variable thickness causes the formation to form limestone interbeds that range from regular to irregular and contrast with black shale and gray limestone in core samples (Patchen et al., 2004). This has caused geologists to label the unit as transitional, from a shallow sea to a deep ocean environment.

METHODS

All research and analyses were conducted in the Subsurface Energy Materials Characterization and Analysis Lab (SEMCAL) and the Trace Element Research Lab (TERL) at The Ohio State University School of Earth Sciences. The sample chosen was JP 10,930 of the Point Pleasant formation and was supplied by Steve Chipera and Chesapeake Energy. The Point Pleasant tends to be the preferred formation target for hydraulic fracturing compared to the Utica. This sample was is located in Washington County Pennsylvania at a depth of 10,930 ft. below the surface. The sample has an average Ro maturity of 2.59 which indicates it was located in the gas window in terms of thermal maturity (Table 1). The sample was examined under light and scanning electron microscopy (SEM) to determine the spatial distribution of carbonate, sulfide, and sulfate minerals of interest and select specific areas for elemental analysis. SEM backscattered electron images (BSE) were analyzed using grayscale percentage to determine microscale mineralogy for barite using ImageJ. Induced coupled plasma mass spectrometry laser ablation (ICP-MS-LA) was used to determine concentrations and distributions of trace elements across selected mineralogical and textural regions in the sample.

Leica DMS 1000 Microscope

The Leica DMS1000 digital light microscope allowed for low magnification (up to 300x), high resolution images. Image capturing hardware and image processing software platform allowed further sample interpretation, measurement, and image presentation. This image analysis was used to identify key areas of interest for SEM analysis. The high resolution images allow a more macro-scale form of image analysis compared to the SEM that aided in correlating images between the SEM and Laser Ablation Microscope for ICP-MS-LA.

FEI Quanta 250 FEG SEM

Analysis of mineralogical, grain, and pore characteristics was performed using a FEI Quanta 250 Field Emission Gun SEM. Prior to analysis, the sample was carbon coated with an SPI carbon coater. Carbon was chosen over gold-palladium because the coating doesn't overlap with the energy range of most elements of interest during energy dispersive X-ray micro analysis. Both secondary and backscattered electron images were acquired. A backscattered electron (BSE) detector acquires signals from electrons that interact deeply with the sample and deflect into the BSE. Higher-atomic mass elements scatter electrons more strongly, and are therefore brighter than lower atomic mass elements. The atomic mass contrast helps indicate chemistry of the rock. A secondary electron (SE) detector allow the user to produce images that show enhanced topography. This detector operates by using low energy electrons that only interact with the surface of the material.

Images acquired were then analyzed to determine mineral distribution and association which are important parts of microtextures for the sample. Micro-scale analysis is important because it can tell us a great deal about porosity, permeability, and diagenesis. Spot micro analysis was performed using a Bruker energy dispersive X-ray spectrometry (EDXS). Mineral mapping is also available using to Quantitative Evaluation of Minerals by SCANning electron microscopy (QEMSCAN), which identifies minerals based upon EDXS spectra and BSE grayscale intensities, as compared a list of standards obtained under similar experimental conditions.

The entire sample was mapped in a grid pattern with a 400 μm scale with backscattered electrons. These images were taken by Alex Swift. I used the information available to estimate the

amount of barite present. Backscattered electron images were analyzed for microscale bulk mineralogy using ImageJ. Calculation of known minerals with grayscale threshold allowed for determination of bulk mineralogy using scales from the SEM image as a known measurement. This method was used to estimate the amount of barite, carbonate, and aluminosilicate clay. Barite was identified with BSE because its heavy molecular weight allows it to displays a nice bright image. The SEM was preferred for this reason to identify areas of interest for ICP-MS-LA without causing severe damage to the sample.

ICP-MS-LA

Concentrations and distributions of trace elements across selected mineralogical and textural regions of the sample were analyzed using ICP-MS-LA. This method by firing a focused argon laser beam at the sample to generate fine particles from a Photon Machine Analyte G2 Laser Ablater. The particles are then transported to an Element 2 high resolution mass spectrometer. The ICP source converts the atoms of the elements in the sample to ions which are then separated and detected by the mass spectrometer by their mass to charge ratio. This method allows the collection of highly sensitive chemical analysis including: bulk analysis, local inclusion and defect analysis, depth profiling, & elemental/isotope mapping with a solid sample (Almirall et al., 2012).

The main advantage to using this approach is that it allows chemical analysis down to parts per billion (ppb). Since the samples are in solid form the results have a lesser chance for contamination, sample loss, and preparation related hazards compared to dissolution methods with ICP-MS. This approach allows samples to be performed without the need for a complex vacuum system and results are available within seconds.

Disadvantages with this approach compared with dissolution methods include having a sample that could be less representative of the bulk. However, multiple sampling locations were utilized to increase sample size representation. Detection limits are higher than dissolution methods due to a smaller mass entering the ICP-MS. This can complicate things because when using ICP-MS-LA matrix matched standard reference materials are often unavailable. This is important because "accurate quantification of the ablated mass is directly correlated to the ablation rate, which is inherent to the respective sample matrix" (Almirall et al., 2012 pg. 23). However, applications of NIST series glass standards for quantification have yielded successful results for accuracy when using the preferred concentration numbers from Pearce et al. (1997). A final issue with laser ablation is fractionation which is affected by laser irradiance, wavelength, thickness, and the pulse interval (Almirall et al., 2012). This was reduced using higher laser irradiances and shorter pulse durations with a 10 by 10 μm beam.

Data Interpretation

Major elements Mg, Ca, Sr, Ba, Al, Na, Ti, Fe, S, Si and minor elements Mo, Mn, Ni, Zn, La, Ce, U, Th, and Rb were profiled for analysis. Other elements besides barium and strontium were analyzed to observe geochemical relationships among elements in mineralogical/rock textural features. Data were collected using rapid peak-hopping between selected mineralogical and textural features for periods of 60-200 seconds. Two glass reference materials NIST-610 & NIST-612 were used for calibration using preferred concentrations reported by Pearce et al. (1997). The major cations Na, Ca, Al, and Si were measured as oxides and then calculated to ppm as the element. The NIST concentrations were compared to Bruker EDXS spot chemical analysis for major cations.

Results were given in counts per second and then calculated to ppm using the average signal background to calibrate sensitivity values.

Equations Used

$$Sensitivity = \frac{Avg.Backround\ Signal}{(Pearce, 1997)Preferred\ Avg.}$$

$$Concentration(ppm) = \frac{Signal\ Strength}{Sensitivity}$$

For Oxides (Si, Na, Mg, & Al)

$$Concentration(ppm) = \left((oxide\ wt\%)x\left(\frac{AW}{MW\ Oxide}\right)x10{,}000\right)x\left(\frac{Signal\ Strength}{Sensitivity}\right)$$

AW=atomic weight of element

MW=molecular weight of oxide

RESULTS

Important properties of bulk samples were measured by Chesapeake Energy (Table 1) and made available for analysis. Although the sample of interest is classified as a shale, about half of the sample is composed of carbonate minerals, and about 20% is clay (Table 1). Other than calcite, minerals that make up a large portion of the non-clay minerals are quartz (SiO_2) (14.8%) organic carbon (4.1%), plagioclase ($NaAlSi_3O_8$) (3.9%), and dolomite ($CaMg(CO_3)_2$) (2.9%). The majority of the clay fraction is illite $(K,H_3O)(Al,Mg,Fe)_2(Si,Al)_4O_{10}[(OH)_2,(H_2O)]$ and micas (17.1%) with a small percentage of illite/smectite (4.3%) and chlorite $(Mg,Fe)_3(Si,Al)_4O_{10}(OH)_2 \cdot (Mg,Fe)_3(OH)_6$ (0.3%).

Table 1: Mineralogical and petrophysical data for sample JP 27P 10930 from Chesapeake Energy

WEIGHT PERCENT	Raw Data **NORMALIZED** to sum 100%
WELL NAME	**JP**
STATE	Penn
COUNTY	Washington
SAMPLE ID	73
OSU ID	**27**
USANS priority	1
SAMPLE DEPTH	10930.68
Average Ro (Maturity)	2.49
Bulk Density g/cc	2.468
A-R Grain Density g/cc	2.622
DRY Grain Density g/cc	2.648
Porosity % of BV	7.4
NON-CLAY FRACTION	
Quartz	14.8
K-Feldspar	1.0
Plagioclase	3.9
Organic Carbon (TOC)	4.1
Apatite	0.9
Pyrite	1.2
Marcasite	
Calcite	49.5
Dolomite	2.8
TOTAL	78.2

CLAY FRACTION	
Mixed-Layer ILLITE/SMECTITE (Includes R3)	4.3
Illite + Mica	17.1
Chlorite	0.3
TOTAL	21.8
GRAND TOTAL	100.0
% Expandable Layers in I/S	23.6
% I/S to Illite in <1.0um Fraction	27.9
% Expandable I/S Layers in sample	1.02
% Fe in the Dolomite/Ankerite	n/a

Leica images prior to SEM and ICP-MS-LA

Leica DMS1000 microscope was used to observe mineralogical and textural features at a lower magnification than an SEM (less than 300x). JP 10930 is a sample that is carbonate rich and there are numerous carbonate structures present. The size variation of the carbonate shells range from as long as 5mm or more (Figure 2) to less than 1mm. There were carbonate shells present with pyrite (FeS_2) replacement on parts of the shells (Figure 3A). Closer observation of the pyrite structures shows two different mineralogical structures: tiny circular structures which appear framboidal (Figure 3B) and block shaped structures which seem to be replacing the carbonate structures (Figure 3A). The carbonates also have assemblages where they form an ellipsoid shape and possess a finer dark texture (Figure 3C). The dark texture could be micritic cement, disarticulated carbonate debris, multiple carbonate shells together or another mineralogical feature. The most surprising result was the presence of a darker outer layer on the underside of the larger hook carbonates (Figure 3B). This could possibly indicate a chemical change in mineralogical composition.

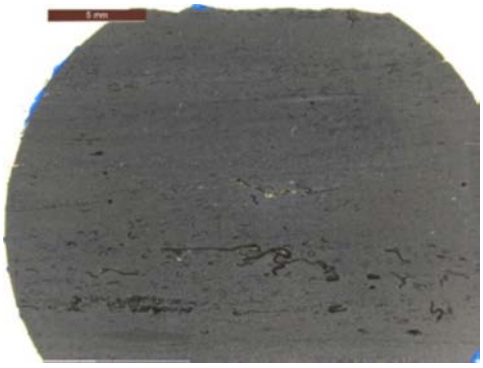


Figure 2: **Chesapeake sample 10930 27P with Leica DMS 1000 depicting multiple pyrite and carbonate rich areas (Scale bars = 5mm)**

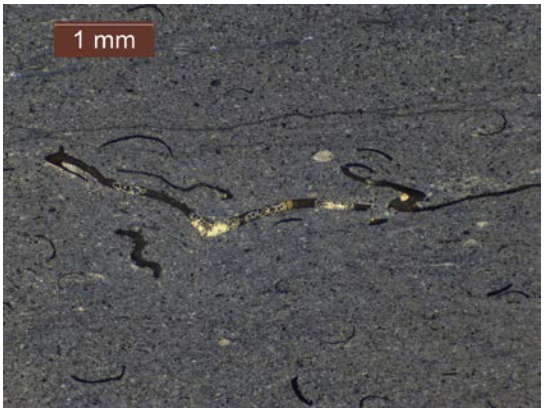


Figure 3A: **Bowtie carbonate with pyrite replacement**

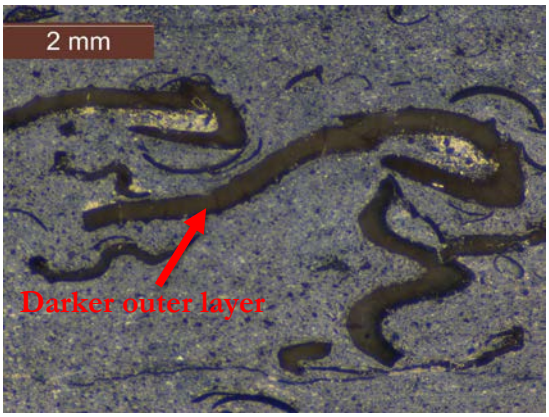


Figure 3B: **Hook shaped carbonate depicting both replacement and framboidal pyrite**

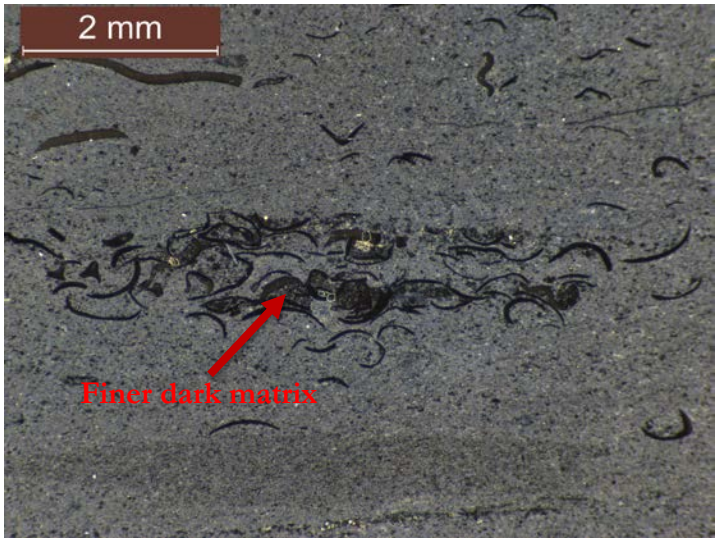


Figure 3C: **Carbonate mass with finer dark matrix of either micritic cement, disarticulated carbonate debris, multiple carbonate shells together or another mineralogical feature**

SEM and EDXS

Samples were analyzed to determine physical and chemical characteristics at a smaller scale than what was possible with the Leica DMS1000. BSE images suggest that the sample is mineralogically and texturally heterogeneous. This is much more noticeable in SEM images than in the Leica images. For example, when comparing Figure 4A to Figure 4B the pyrite structures vary more considerably in the SEM image (Figure 4A) than what was evident from the Leica (Figure 4B). There are both framboidal and massive pyrite textures present with each other indicating two

different mechanisms of formation. The framboidal pyrite formations are often mixed with clay matrix, Ca-phosphates, or quartz (Figure 4A and 4C).

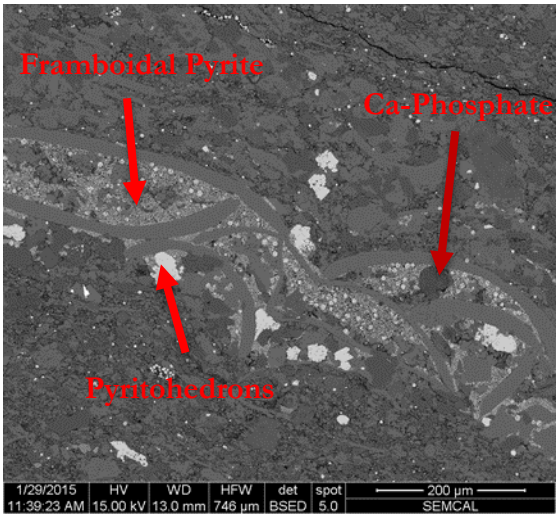


Figure 4A: **Carbonate, framboidal pyrite, pyritohedron, and Ca-phosphate assemblage with closeup of the heterogeneous matrix**

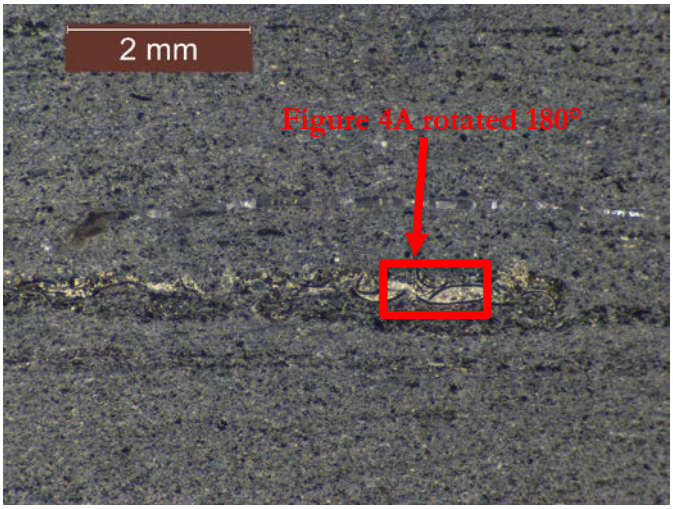


Figure 4B: **Insert shows area of image 4A on the Leica DMS1000**

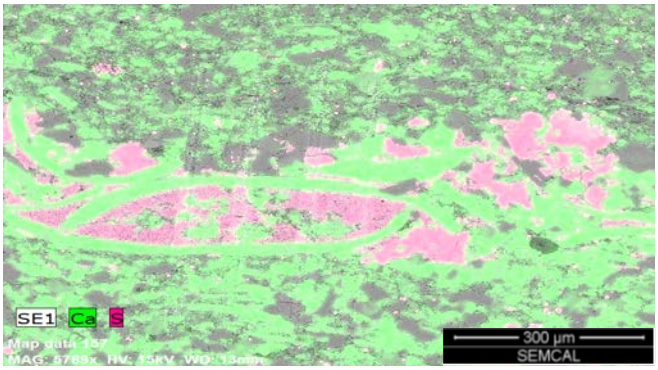


Figure 4C: **Carbonate, framboidal pyrite, and pyritohedron assemblage from figure 4 with Ca and S map post laser ablation**

SEM images also reveal the presence of barite in multiple areas throughout the sample. Most barite was found as grain aggregates (Figure 5) or associated with pyrite, but is also barite present in a barite/Ca-phosphate assemblage in one particular area (Figure 6A). Analysis with EDXS also confirms the presence of strontium in barite in Figure 5. EDXS analysis with strontium however can be difficult to determine due to silicon and strontium sharing very similar peaks. To confirm strontium presence from silicon with EDXS results laser ablation was used. The presence of strontium with barite indicates that the barite minerals could contain celestite in the form of a barite/celestite solid solution (Figure 5). Strontium was found in some of the carbonate shells

sampled with EDXS. This is not unexpected because strontium can substitute for calcium in the calcite crystal structure due to the similarity in ionic radii (within the 15% size difference), thus satisfying Goldschmidt's replacement rule to form strontianite. The highest concentration sampled had an overall weight percent $SrCO_3$ of .93%mol $SrCO_3$ and the highest weight percent $MgCO_3$ was 6.47% mol $MgCO_3$ (Table 2). Weight percent values and elemental ratios were calculated stoichiometrically based on EDXS observed weight percent.

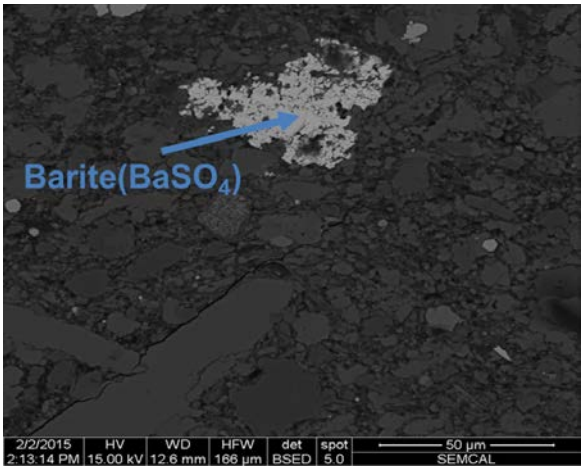
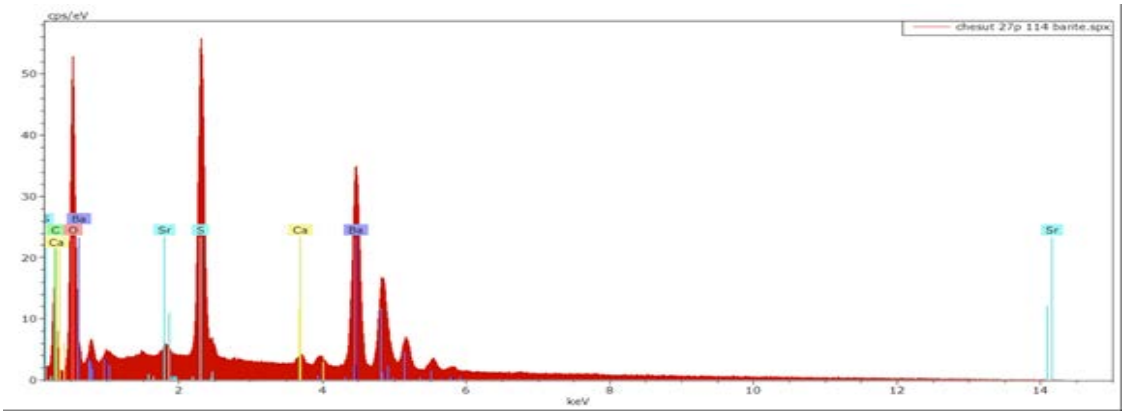


Figure 5: Diagenetic barite replacement texture present as indicated from energy dispersive x-ray spectrometry (EDXS)



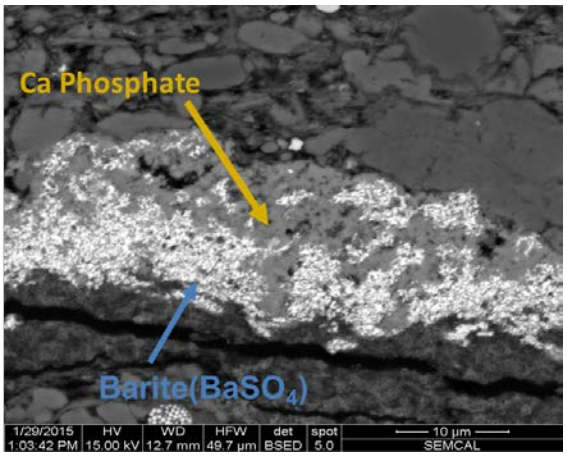


Figure 6A: Closeup of barite and Ca-phosphate assemblage

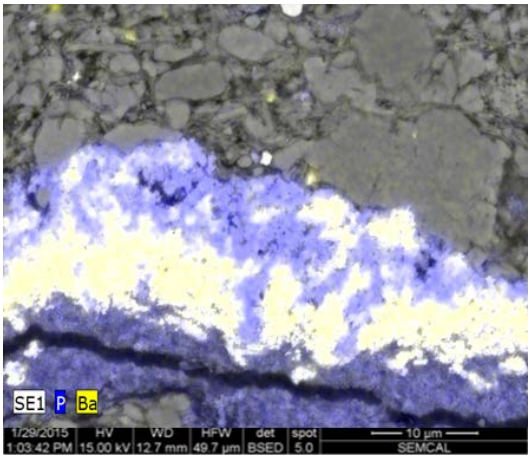


Figure 6B: Ca & Ba map of figure 6a this is Ba and P

Table 2: Bruker Spot analysis of four carbonate from Sites D, C, A, & B in that order

bowtie (Matt Edgin)								
Element	**wt %**	**atm weight**	**atm prop.**	**O2 Factor**	**basis of 3 oxygens**		**Mg/Ca**	**Sr/Ca**
Ca	44.01	40.078	1.098		2.082		0.018	0.022
Mg	0.781	24.305	0.032		0.061		**%MgCO3**	**%SrCO3**
Sr	0.975	87.62	0.011		0.021		2.815	0.975
C	7.724	12.0107	0.643		1.219			
O	25.311	15.994	1.583	1.896	3.000			
					total cations			
					2.164			
smaller shell 011								
Element	**wt %**	**atm weight**	**atm prop.**	**O2 Factor**	**basis of 3 oxygens**		**Mg/Ca**	**Sr/Ca**
Ca	41.356	40.078	1.032		1.229		0.010	0.000
Mg	0.415	24.305	0.017		0.020		**%MgCO3**	**%SrCO3**
Sr	0	87.62	0.000		0.000		1.628	0.000
C	11.294	12.0107	0.940		1.120			
O	40.28	15.994	2.518	1.191	3.000			
					total cations			
					1.250			
hook middle009								
Element	**wt %**	**atm weight**	**atm prop.**	**O2 Factor**	**basis of 3 oxygens**		**Mg/Ca**	**Sr/Ca**
Ca	44.538	40.078	1.111		1.761		0.042	0.007
Mg	1.875	24.305	0.077		0.122		**%MgCO3**	**%SrCO3**
Sr	0.305	87.62	0.003		0.006		6.472	0.292
C	10.64	12.0107	0.886		1.404			
O	30.28	15.994	1.893	1.585	3.000			
					total cations			
					1.889			
calcite003								
Element	**wt %**	**atm weight**	**atm prop.**	**O2 Factor**	**basis of 3 oxygens**		**Mg/Ca**	**Sr/Ca**
Ca	41.168	40.078	1.027		1.273		0.029	0.008
Mg	1.18	24.305	0.049		0.060		**%MgCO3**	**%SrCO3**
Sr	0.338	87.62	0.004		0.005		4.497	0.357
C	9.813	12.0107	0.817		1.013			
O	38.717	15.994	2.421	1.239	3.000			
					total cations			
					1.338			

Multiple EDXS measurements were taken at laser ablation sites to calculate the weight percent of the major cations. This was done to help calibrate the ICP-MS-LA calculations since the areas examined with the EDXS were good representations for standard reference material. This allowed for more accurate calculations.

Barite Estimation Calculation

Analysis of BSE images with ImageJ was done by selecting 10 BSE images using grayscale values to identify barite. Results revealed that barite represented less than one percent of the total mineralogy of the sample (table 3). Calculations were done by converting the images to 8-bit and using the scale from the BSE SEM image as a known measurement. With the adjust threshold feature on ImageJ, images that were known to contain barite, carbonate shells, and clay from EDXS had grayscale values that could be quantified. This was done by adjusting the threshold value specific to each mineral which highlighted them and allowed the same values to be used for other images (200-240 for barite). Using the values for the grayscale threshold and the SEM scale ten images were selected at random that contained representations of all three mineralogical features present. The mineralogical features were highlighted with the adjust threshold feature to get an approximate area and then divided over the total area of the image to get a percentage.

Table 3: **Microscale bulk analysis barite with ImageJ**

IMAGE NUMBER	BARITE AREA (μm^2)	IMAGE AREA (μm^2)	BARITE %	CALCITE %	CLAY %
1	18,800	1,300,000	1.45	45.29	36.99
2	61.9	9,080	0.682	57.69	22.06
3	2,470	949,000	0.260	37.36	22.15
4	212	1,161,563	0.018	57.69	22.17
5	1,170	1,190,000	0.098	31.97	23.48
6	502	1,190,000	0.042	48.23	26.54
7	1,567	1,190,000	0.132	50.32	26.47
8	1,010	1,190,000	0.085	33.04	20.00
9	2,620	1,170,000	0.224	51.97	23.48
10	987	1,180,000	0.084	38.08	21.53
	TOTAL	TOTAL	TOTAL	TOTAL	TOTAL
	29,401	10,529,643	0.280	45.16	24.49

Induced Coupled Plasma Mass Spectrometry Laser Ablation

Laser ablation sites were chosen based on SEM analysis of potential strontium and barium sources. Dresel and Rose, 2010 list typical concentrations of 580ppm Ba and 300 ppm Sr for shale's and 600ppm Sr and 10 ppm Ba for limestones for the Marcellus Formation. Several ablation lines where done to analyze chemical concentrations across specific mineralogical and textural features. Site A and B (Figure 7) show four ablation lines were done along the long axis of fossil carbonates across the center, edge, and surrounding matrix. These sites were selected to observe concentrations at specific sites within the shells. Sites C, D, and E (Figure 7, 8, and 9) had vertical ablation lines that were drawn across the short axis of the carbonate shells to observe differences in trace elemental compositions from the middle to the edge. It should be noted that because the NIST glass standards for Ca, Na, Al, and Si were measured in oxides (CaO, Na_2O, Al_2O_3, & SiO_2) their concentrations had to be calculated from weight percent to ppm from the mass spectrometer calculations. The unavailability of matrix matched standard reference materials made calibration of the major cations from Bruker EDXS necessary to improve the accuracy.

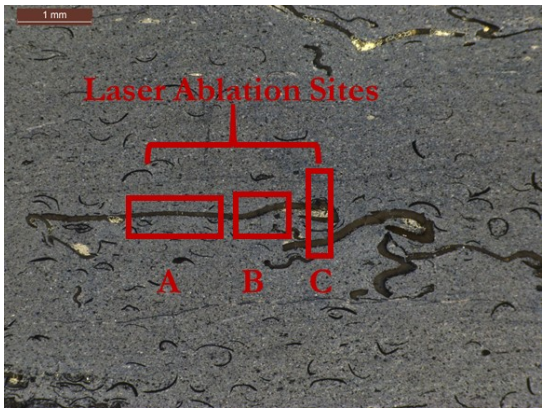


Figure 7: **Leica image of the hook fossil carbonate assemblage with laser ablation sites outlined A. Lengthwise carbonate traverse B. Lengthwise carbonate traverse bulge C. Hook carbonate vertical slice**

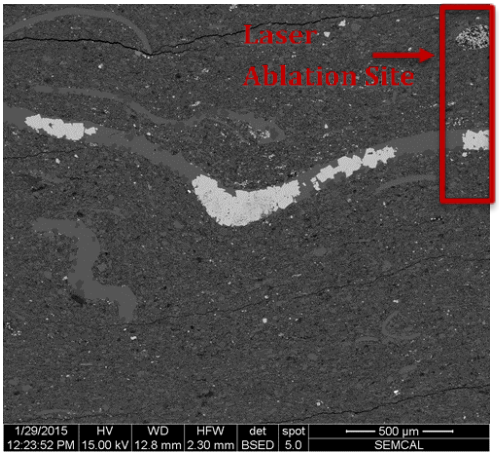


Figure 8: **SEM image of bowtie carbonate with laser ablation site D outlined**

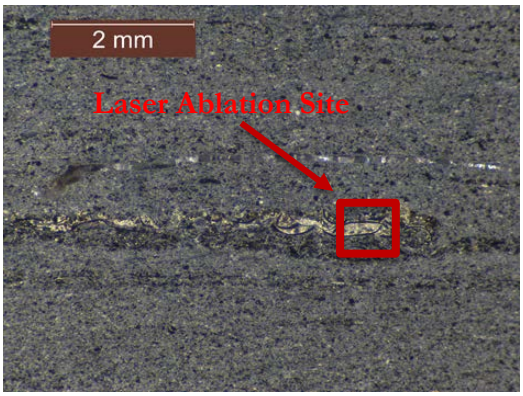
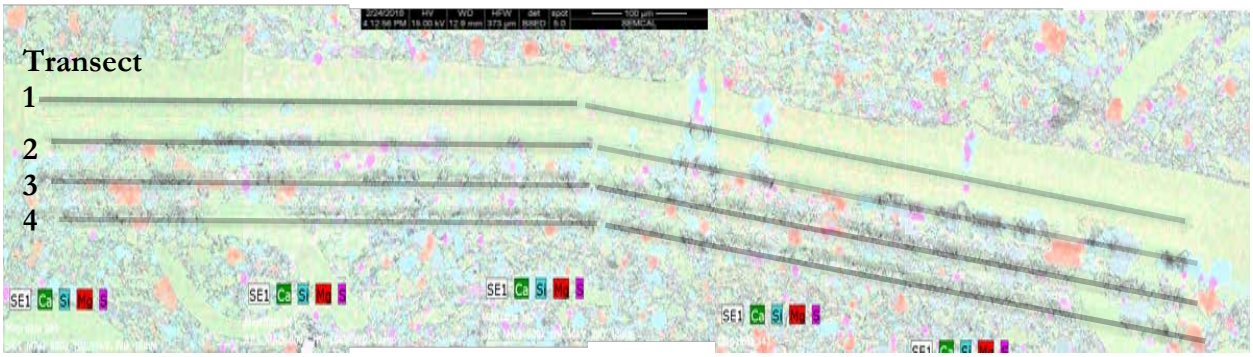


Figure 9: **Leica image of carbonate and pyrite assemblage with laser ablation site E outlined**

Carbonate Shell Site A Center

The bright green areas as indicated from Figure 10 show a large carbonate shell that is greater than 5mm long (Figure 7). The carbonate shell, although fairly uniform does contain some grains of Si (Figure 10 blue) which could indicate quartz (SiO_2), albite ($NaAlSi_3O_8$), or clay as well as S(Figure 10 fuchsia) which probably correlates with pyrite. These color changes on the carbonate structure (green Figure 10) from green to cyan and fuchsia indicate avenues for mineral replacement from fluids. Overall, the large Ca signature (Figure 10 green) suggests that the structure is largely calcite. It should also be noted here that there are red regions signifying higher concentration of Mg (Figure 10 red) which are probably either dolomite or high-Mg calcite. This could be from further alteration during diagenesis from dolomitization.



<u>Figure 10:</u> Stitched image of Ca, Si, Mg, & S maps of Site A post laser ablation

The long axis laser ablation lines in the carbonate shells were fairly uniform for Ca, Mg, and Sr throughout and had clear drops where inclusions are shown to occur from SEM images. Barium showed highest concentrations in the inclusion areas (350 ppm) as compared to the carbonate and pyrite areas (cyan spots in Figure 10 and Figure 11). These areas could be secondary albite or quartz. Strontium was fairly uniform with concentrations ranging between 3200-3600ppm (Figure 12). The strontium spike at about 1000 μm appears to occur right around a fracture or inclusion which represent a change in mineralogy. Sodium was fairly uniform with its concentrations slowly decreasing with distance from 1560ppm to about 1480ppm with the exception of a spike around 1000 μm which could indicate a mineralogical change.

All measurements were done along Transect 1 as indicated in Figure 10. Strontium has a strong correlation with calcium and magnesium in the carbonate shells (Figures 11 and 12). When comparing barium to calcium and sodium concentrations, there appears to be an inverse correlation. The barium spikes seem to occur where the silicon spots in Figure 10 are highlighted. The inverse correlations in these areas could be related to a change in mineralogy from carbonate to illite or albite. Overall, the inverse correlation appears to be stronger with calcium than sodium because spikes with barium do not always align with decreases in sodium (Figure 10). Areas where both barium and sodium spike together could be related to mineralogy because both can be present in feldspar or illite. This indicates a mineralogical change and/or geochemical relationship between barium and both calcium and sodium. The position-timing of the barium spikes with the SEM image may be slightly off due to the mass spectrometer calculating the peak hop slightly later than when the sample was ablated.

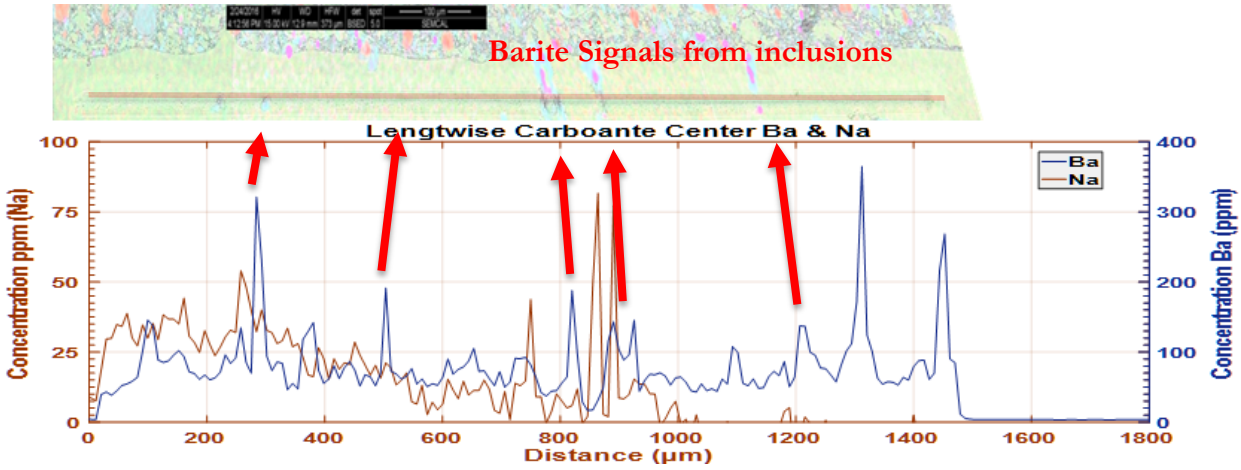


Figure 11: Lengthwise carbonate shell traverse ICP-MS-LA for Na & Ba

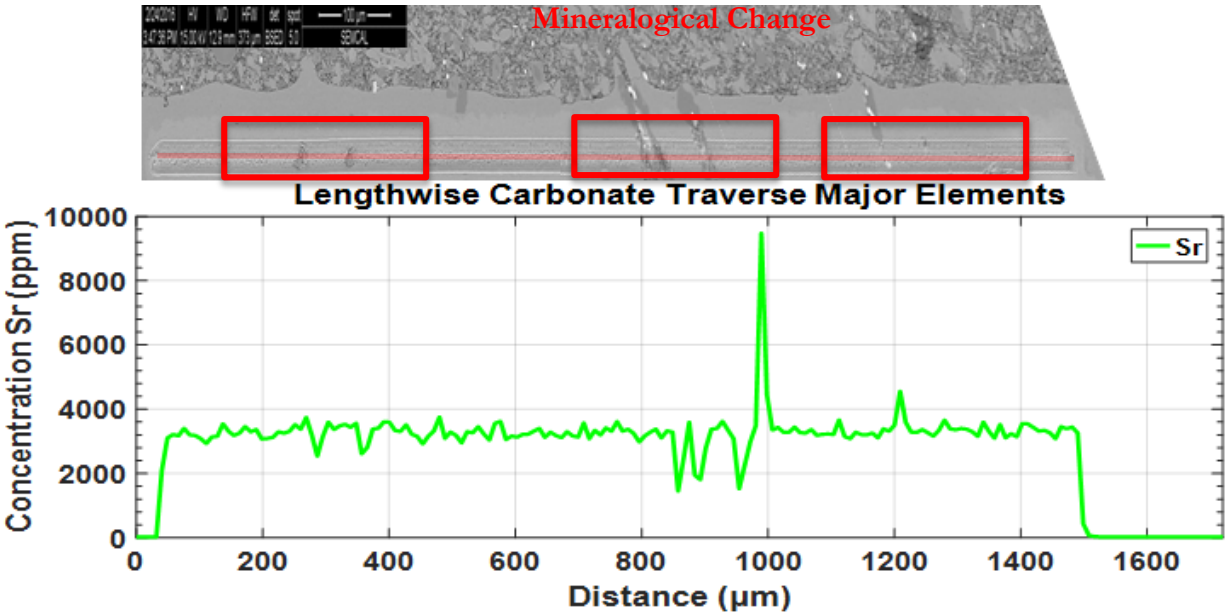
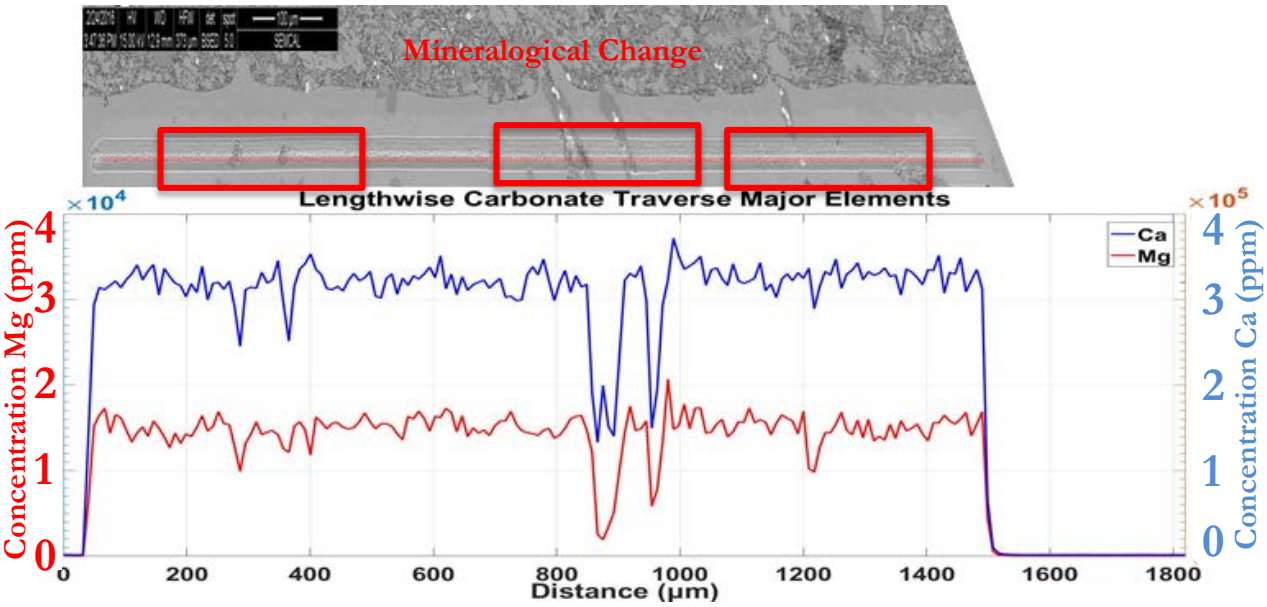


Figure 12: Lengthwise carbonate shell traverse ICP-MS-LA for Sr



<u>Figure 13:</u> Lengthwise carbonate shell traverse ICP-MS-LA for Ca & Mg

Carbonate Shell Edge Site A

The next set of measurements targeted the edge of the carbonate shell and there is a clear change in mineralogy from the edge to the center of the shell. Although, for the edge and matrix laser ablation lines there is a large proportion of carbonate present it is more diverse mineralogically than the center of the carbonate shell. Spikes in sodium that correlate with barium indicate a feldspar presence whereas spikes in barium and decreases in sodium could indicate aluminosilicate clays. There is also more magnesium present here as indicated from magnesium spikes and EDXS which indicates dolomite, dolomite cements or high-Mg calcite (Figure 14). All measurements for calcium, magnesium, barium and sodium were made along Transect 3 while strontium was measured along transect 2 and 3.

Barium concentrations seem to show an inverse correlation with calcium and sodium but it is not consistent throughout the run. This could be due to feldspar presence causing a spike in both sodium and barium or aluminosilicate clays containing both calcium and barium. The magnesium concentrations have lower concentrations in the carbonate shell in Figure 11 (approx. 17,000 ppm) avg.) compared to outside it in Figure 12 (up to 75,000 ppm). When comparing Figure 12 with Figure 10 the spikes seem to correlate with the red Mg grains from the SEM EDXS elemental image which suggests high-Mg calcite, dolomite, or dolomite cement as the calcium signal also increases slightly with the magnesium during the spikes.

The strontium does not vary much but its average concentration (4000ppm) is approximately 800ppm more on the edge than in the middle of the shell (3200ppm) (Figure 15 and 16). It should be noted that for the strontium laser line there was an error and data were not recorded for the entire line. The strontium was also collected on two different lines with minor elements (Mn, Mo, U, Th, Ce, La, Ni, Zn, & Rb) and also major cations (Ca, Al, Mg, Na, Ba, and Ti). This means that for that particular line strontium concentration relationships with major cannot

be constrained. Barium concentrations average 150 ppm, and are higher on the edge and in the matrix (Figure 17) than in the carbonate shells (Figure 13; approximately 70ppm avg.). The calcium concentrations seem to be higher in the middle structure (400,000 ppm) than on the edge and within the matrix (300,000 ppm).

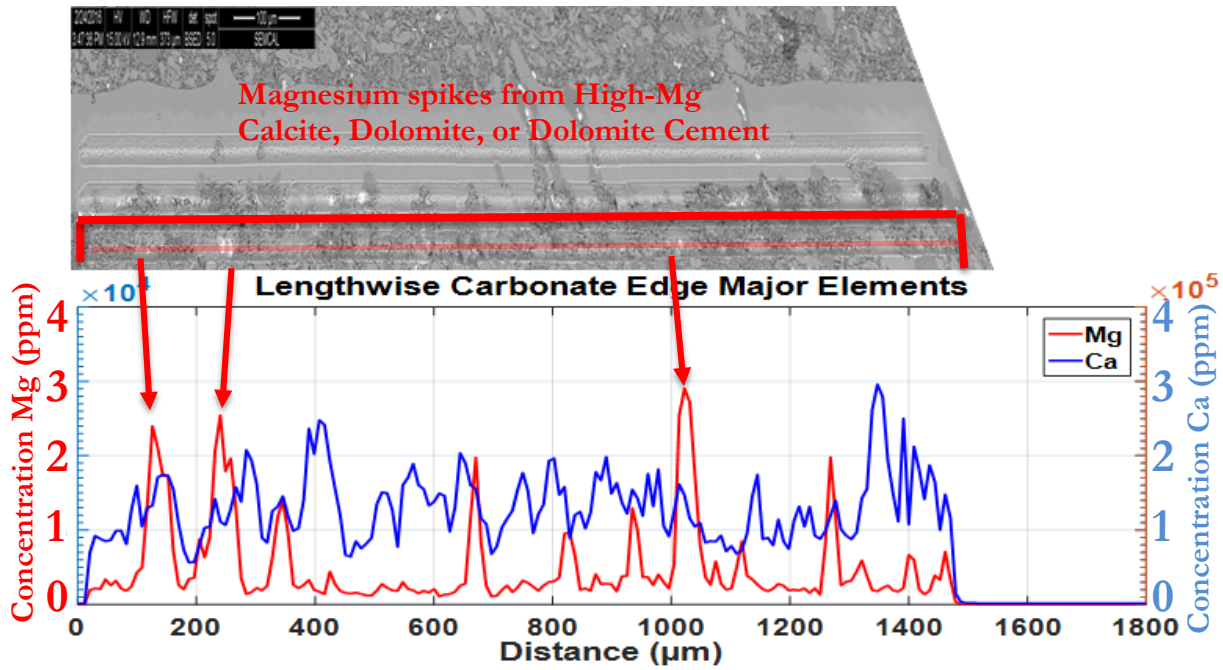


Figure 14: Lengthwise carbonate shell traverse edge ICP-MS-LA for Ca & Mg

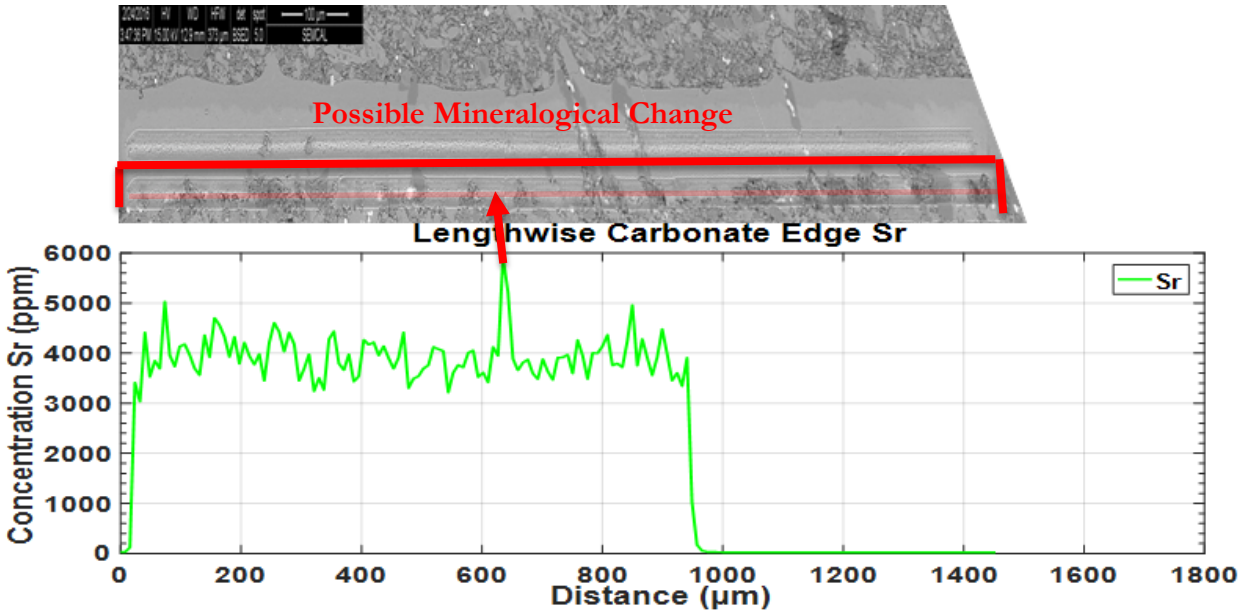


Figure 15: Lengthwise carbonate shell traverse edge ICP-MS-LA for Sr

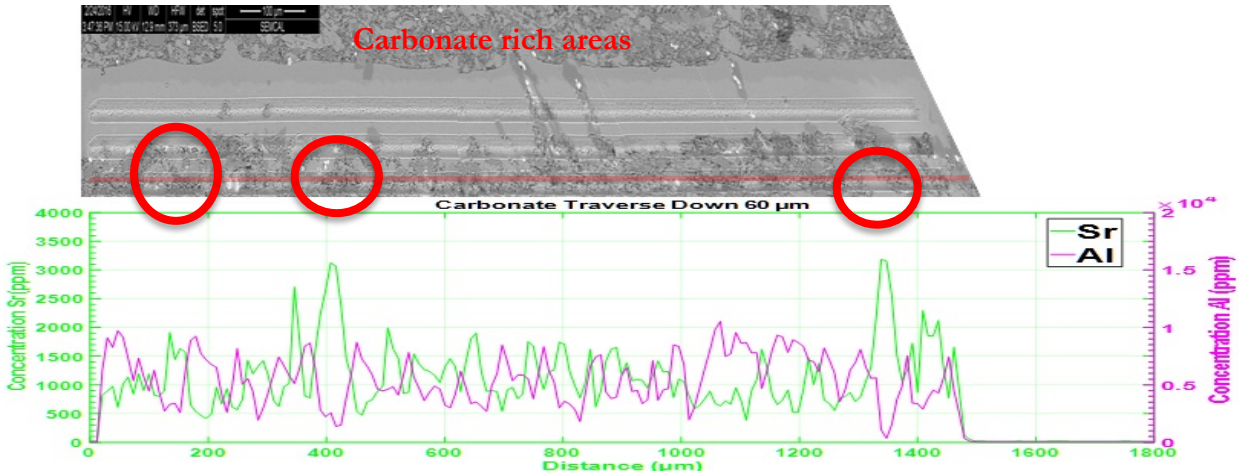


Figure 16: **Lengthwise carbonate shell traverse edge ICP-MS-LA for Al & Sr**

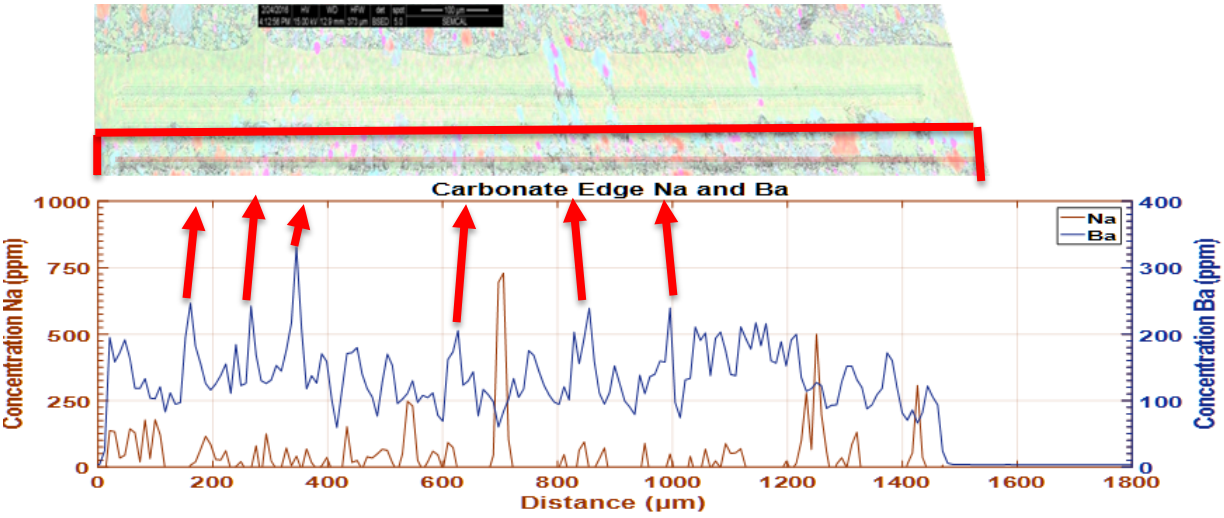
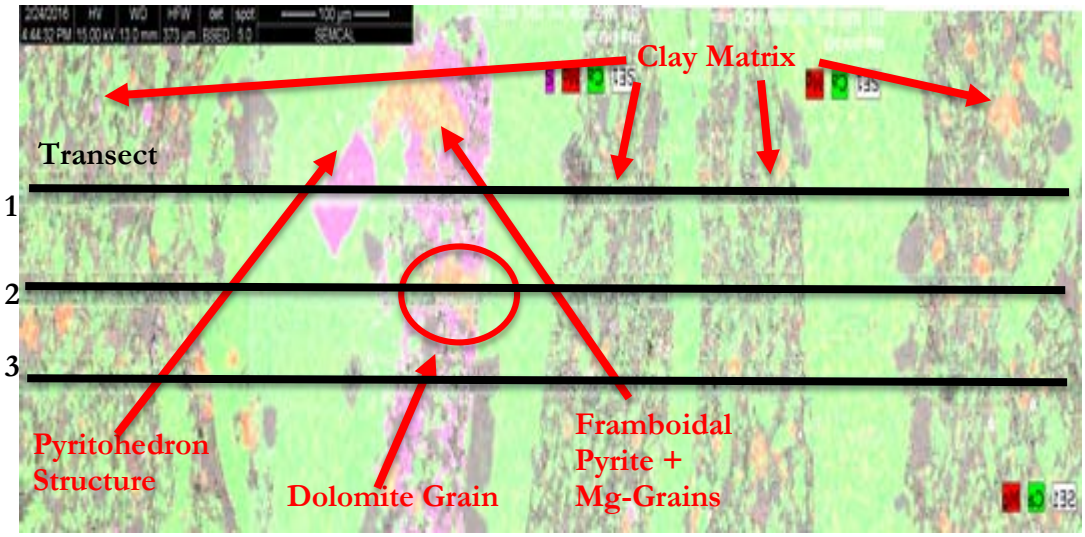


Figure 17: **Lengthwise carbonate shell traverse edge ICP-MS-LA for Na & Ba**

Short Axis Carbonate Shell Site C

The bright green areas indicated from Figure 18 show the same carbonate shell as in Figure 10. The difference for site C is that the carbonate structure was ablated along the short axis to see chemical changes from the edge vs the middle. From the SEM EDXS images this area has S signals from EDXS (Figure 18 fuchsia) which probably correlate with pyrite. There are two different structures present: pyritohedron and framboidal. Overall, the bright solid Ca signal (Figure 18 green) suggests that the structure is largely calcite. The elemental maps also show areas of Mg (Figure 18 red) which are probably dolomite, dolomite cement, or high-Mg calcite. Both the magnesium and sulfur signals indicate alteration during diagenesis (secondary).



<u>Figure 18</u>: Stitched image of Ca, Mg, & S maps of Site C post laser ablation

Short axis laser ablation lines were taken across the hook carbonate structure (site C). All laser ablation measurements were made along Transect 2. The strontium and calcium signals show a strong correlation with each other (Ca in Figure 19 with Sr in Figure 20). This is due to the bright green areas in Figure 18 being carbonates as indicated by EDXS. Spikes correlated with areas that were carbonate rich while drops correlated outside the carbonate rich areas in the clay matrix. The aluminum signals were used to differentiate between the carbonate and the clay or feldspar in the fine-grained matrix and seem to show an almost uniform inverse correlation with calcium to signify this mineralogical change.

Strontium and calcium concentrations are highest in the carbonate structures (green in EDXS elemental map image Figure 18) (4,000-6,000ppm) with the highest numbers being located in the center of the shells. Barium had higher concentrations in the clay matrix (120-300ppm) than in the carbonates (100-200ppm) (Figure 21). Sodium was fairly uniform throughout the run (around 1750ppm) with only a few areas that showed only slight spikes. The concentrations of magnesium stayed between 11,000 and 40,000ppm relatively consistently throughout the line. It is only at about 500 µm that we see a big spike and there is also a slight increase with the Ca signal with it.

Barium has an almost inverse correlation with strontium, calcium, and sodium. This is due to mineralogical changes from carbonates to clay matrix for strontium and calcium and albite and aluminosilicate clays with sodium. The spike in Mg at about 500µm (110,000ppm) shows a clear mineralogical change to dolomite or dolomite cement as indicated by rhombohedral grain shape in Figure 19. The spike in magnesium at 500 µm correlates with an increase in Calcium.

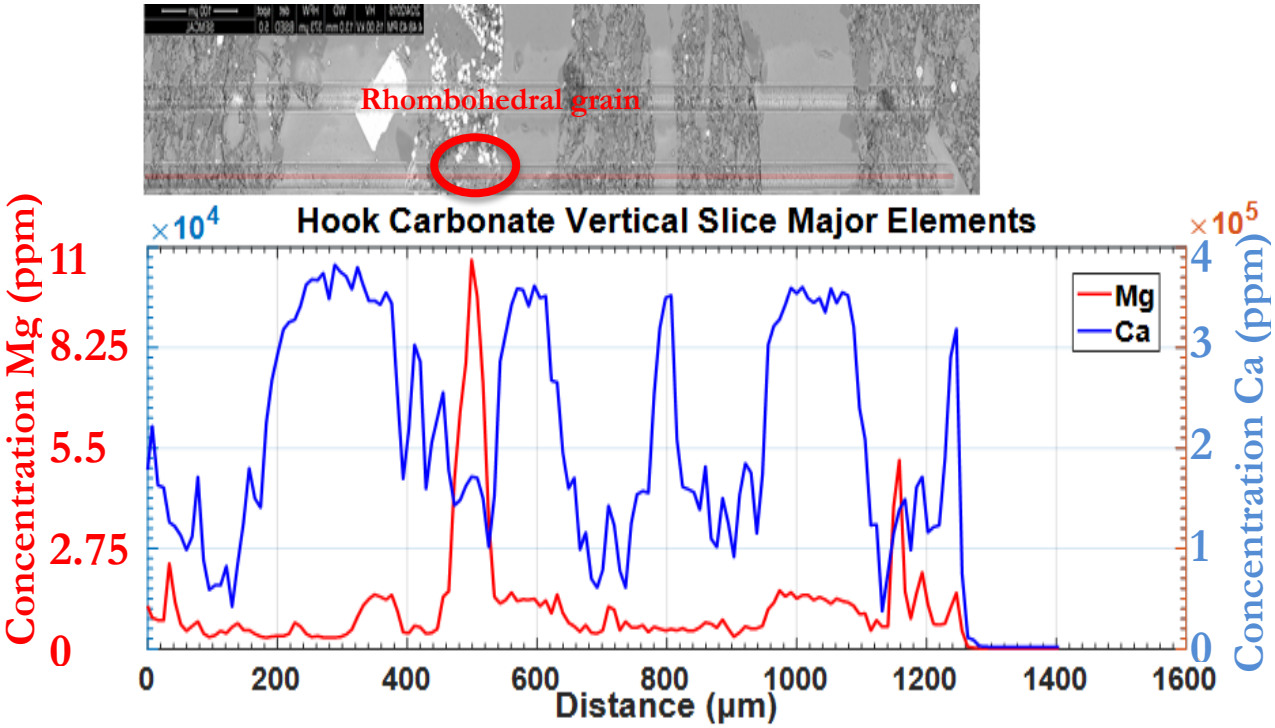


Figure 19: Hook carbonate vertical Slice with Clay Matrix Ca & Mg

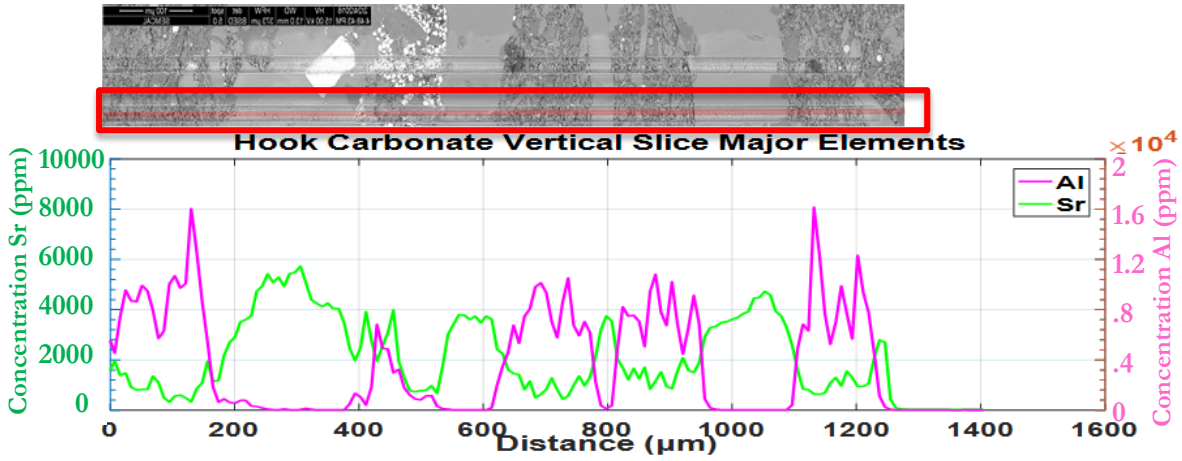
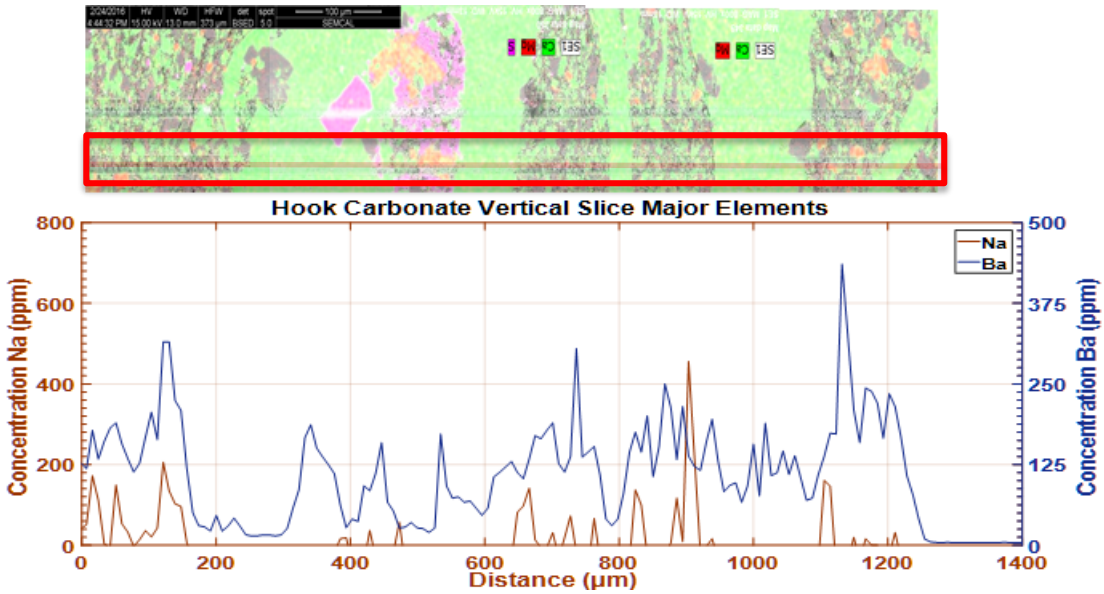


Figure 20: Hook carbonate vertical Slice with Clay Matrix Al & Sr



<u>Figure 21:</u> Hook carbonate vertical Slice with Clay Matrix Ba & Na

Bowtie Carbonate Short Axis Site D

The bright green areas as indicated from Figure 22 show the bowtie carbonate shell as well as an additional pyrite-carbonate assemblage (refer to Figure 8). At this site the carbonate structure was ablated along the short axis to observe chemical changes from the edge vs the middle. However, the pyrite structures here are much larger than those present from Figure 18. From the SEM EDXS images this area has S signals from EDXS (Figure 22 fuchsia. There appears to be two different structures present: pyritohedron and framboidal. Overall, there is a bright solid Ca signal (Figure 22 green) around the pyrite areas which suggests calcite. There are also small fuchsia spots that show S signatures from EDXS which could indicate pyrite, barite, or celestite. There are also more red regions indicating Mg (Figure 22 red) which are probably dolomite, dolomite cement, or high-Mg calcite.

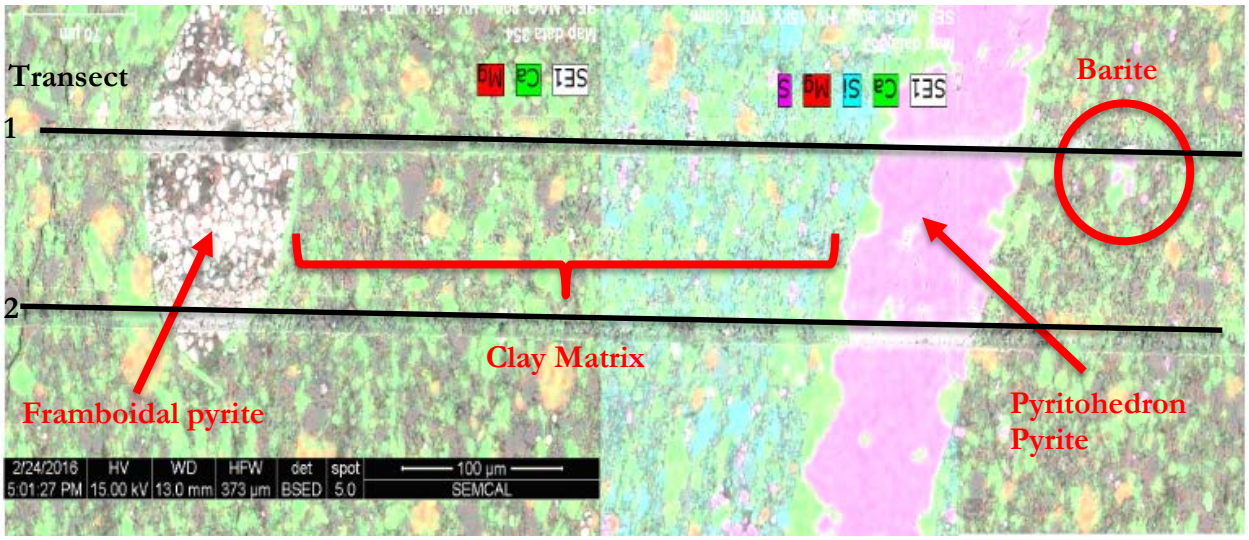


Figure 22: Stitched image of Ca, Si, Mg, & S maps of Site D post laser ablation

Short axis laser ablation lines were taken across the bowtie carbonate structure (site D) as well as across the hook carbonate (Site C). In site D there are carbonates with two different pyrite structures: framboidal pyrite and pyritohedron (Figure 19). Data shows similar trends to the long axis laser ablation lines across the carbonate shells.

All laser ablation measurements were done with Transect 1 (Figure 22). Calcium was highest in the carbonate shells (300,000-400,000 ppm) while magnesium was highest in the clay matrix (Figure 23). Strontium was typically highest in the carbonate shells (3000–4000 ppm) with the exception of a small piece of barite (3000 ppm) (Figure 22 circle). Barite identification was confirmed by observing peaks for both strontium and barium at the same time and a sulfur peak from the EDXS map (Figure 24 & 25). Barium shows a correlation with strontium and no correlation with sodium in the clay matrix (Figures 24 and 25). This could be due to most sodium existing in albite and therefore means the barium in the matrix area must be in the clays. This correlation is suggestive of a relationship with aluminosilicate clays versus carbonates and the presence of barium and strontium.

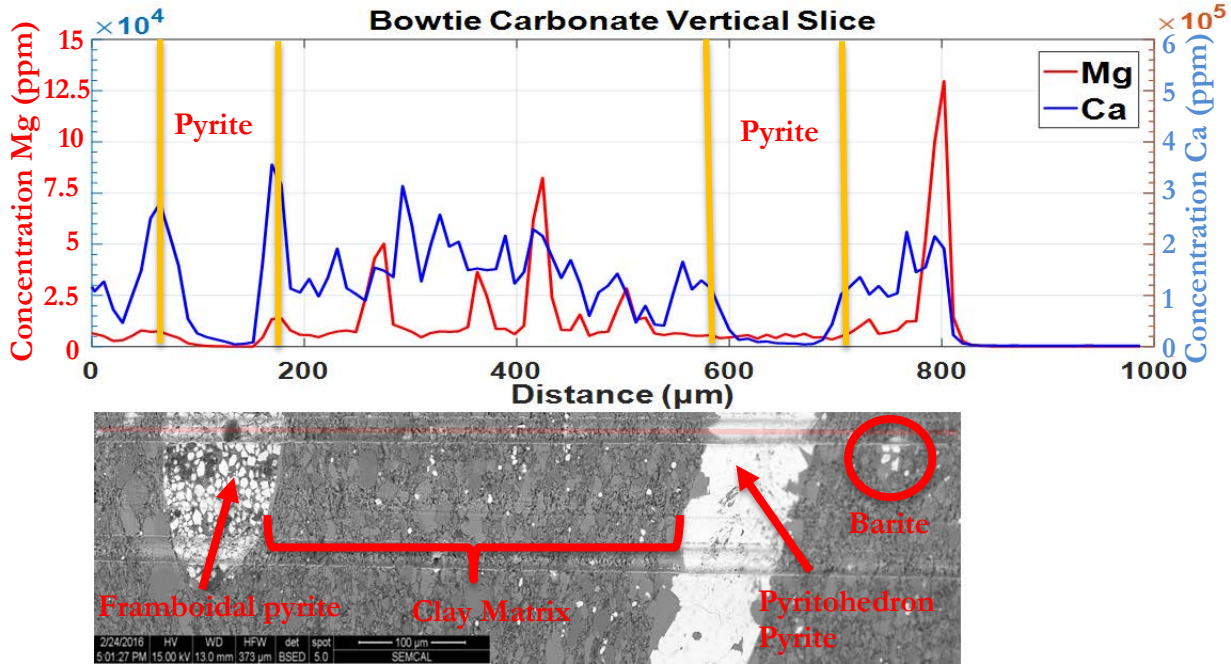


Figure 23: Bowtie carbonate vertical slice with clay matrix Ca & Mg

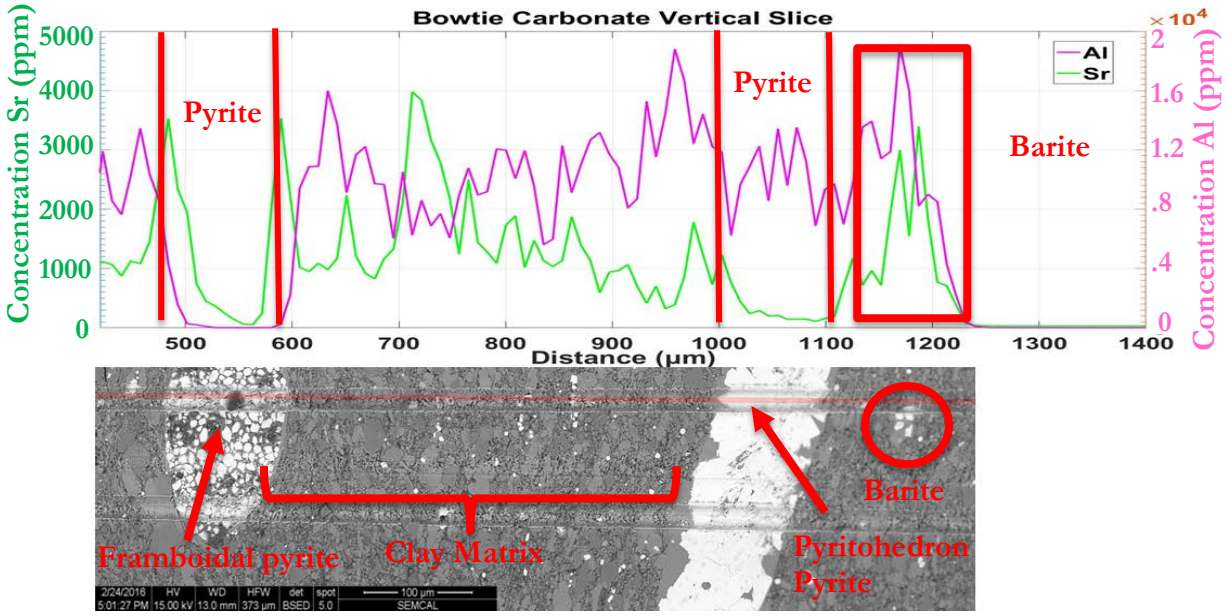


Figure 24: Bowtie carbonate vertical slice with clay matrix Al & Sr

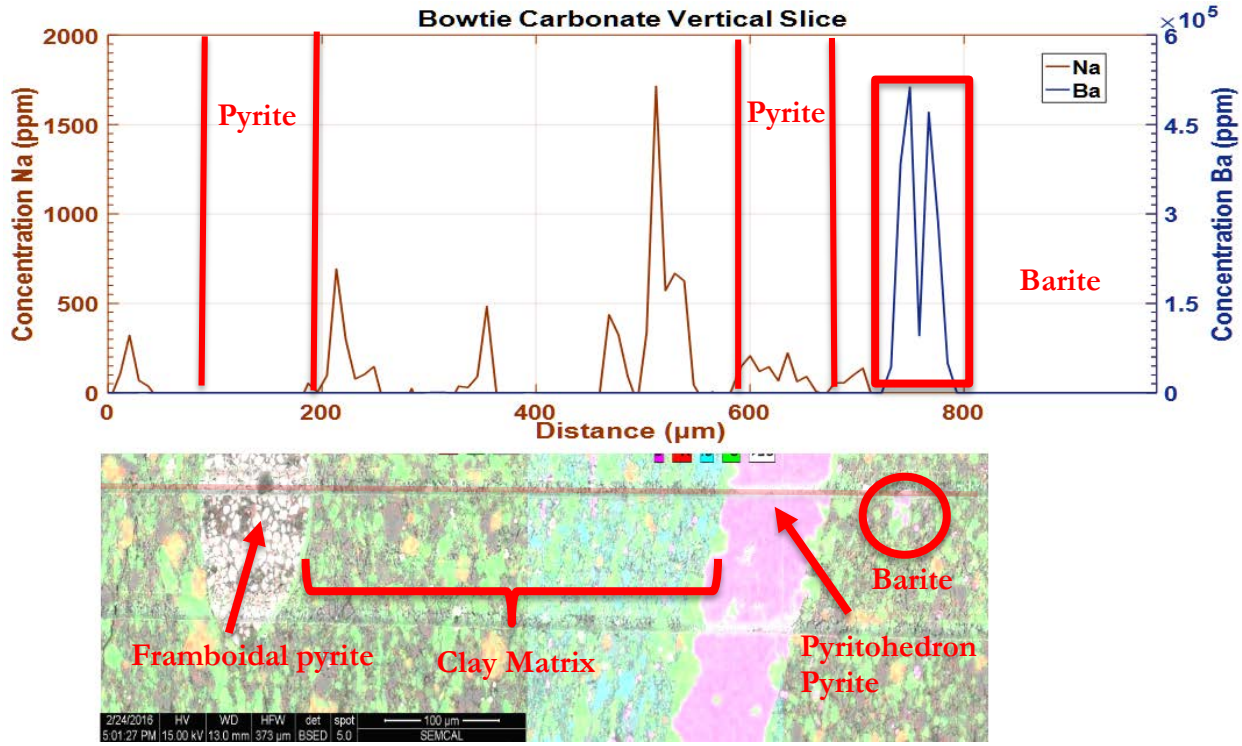


Figure 25: Bowtie carbonate vertical slice with clay matrix Na & Ba

Molar Sr/Ca vs Mg/Ca

The relationship between strontium and magnesium exhibits an interesting correlation for all areas interrogated. The strontium concentrations are higher when the magnesium ratio is less than 0.0425 mol Mg/Ca (Figure 26). However, once the Mg/Ca ratios exceed 0.0425 mol Mg/Ca the

Sr/Ca ratios decrease from 0.007 to 0.005 (Figure 26). This could be due to magnesium's smaller ionic size causing a deformation in the calcite crystal structure that enables larger elements like strontium to fit. Therefore, magnesium had a positive influence on strontium accommodation in the carbonate structure to a certain extent. The decrease after .0425 Mg/Ca could be the point where magnesium alters the crystal structure to something less accommodating to strontium like dolomite.

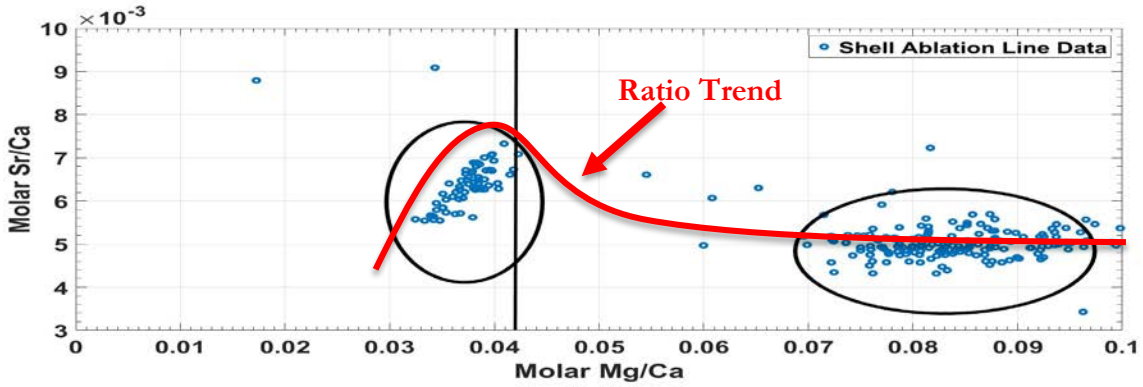


Figure 26: Molar Sr/Ca vs Mg/Ca

DISCUSSION

Barium

Results indicate that, other than barite (up to 500,000 ppm), barium is most concentrated in the clay matrix (approx. 150-600 ppm). Barium concentrations are as much as 70-400 ppm greater in the clay matrix areas than over the pyrite areas and carbonate shells. This is due to the high surface area to volume ratio of the clay matrix, and to barium's ability to be absorbed during authenigenic diagenesis of aluminosilicate clays. The concentrations observed for source rock's potential for barium are within Dresel and Rose's values for shale's (580ppm Ba) and well above the values for limestone (10 ppm Ba) (Dresel and Rose, 2010). Although there is barite in the sample, it than 1% (by volume) from ImageJ analysis suggests that the clay matrix (21.8% Table 1) would be a better source despite having lower concentrations of barite (0.025–0.05weight percent clay versus 60 weight percent in barite) (Table 2). Using the values from Table 2 the total percent of barium in the sample should be 1.36 percent or 0.034g/cc of the sample. The highest amount of barium coming from the clay matrix (67.6%) over barite and the carbonates (Table 4). This means the barium in flowback water should be related to dissolution mechanics of the clay matrix.

Table 4: Calculations of barium in bulk mineralogy from Table 1 and Table 3 data

bulk density sample	2.468 g/cc				
	wt % ba	percent from table 2	den. mineral-x sample	den. Ba in sample	% in mineral from total
barite	60	0.0279	0.000689	0.000413	0.957
calcite	.8	45.16	1.11	0.009	20.7
clay	5.6	24.49	0.604	0.034	78.4
			Total	total in rock	
			1.72 g/cc	0.04g/cc	

Barium Mobilization

One mechanism for barium mobility could be a result of the leaching of salts involved in the drilling process. Laser ablation results exhibited an inverse correlation between barium with calcium and sodium in the clay matrix (Figures 11, 13, 14, 16, 19, 21, 23, and 25). These elemental differences are directly related to changes in mineralogy. Most likely the barium decreases and associated sodium increases are related to sodium from albite whereas the opposite is true for the aluminosilicate clays. The higher values of barium and overall greater volume of the clay matrix

versus barite suggest mobilization might be related to higher overall abundance of barium liberated from aluminosilicate clays (Table 4). This hypothesis has been supported in previous studies which show that under high ionic strength conditions a large inflow of Na^+ and Ca^{2+} will be preferentially accommodated in the in the clay structure (Renock et al., 2016). In fact, when using fluids that are identical to the ionic strength of hydraulic fracturing fluids "between 5 and 25% of the total Ba in the rock can be leached from shales over a contact time of 7 days" (Renock et al., 2016 pg. 81). Therefore, barium in my sample can have as much as 0.026 g/cc or up to 435ppm using Dresel and Rose (2010) values. Therefore, barium in flowback waters from the Utica/Point Pleasant formation could be a result of the high ionic strength of the reactive fluids if fluids can access pores within the clay matrix. Another factor to consider as a barium source is flowback fluids interacting with brines and formation waters in the subsurface. However, the bulk of barium should still be from aluminosilicate clays as indicated from laser ablation results and barium calculations from Table 2 and 4.

Strontium

Results from this study indicate that, strontium concentrations are highest in the carbonate structures and more on the outer edge (800ppm more) than the middle of the carbonate (Figures 11 and 12). Strontium was also present in high concentrations in barite (3000ppm), which is likely due to the mineral being a barite/celestite solid solution. This was also observed in barite with EDXS analysis of barite. Strontium concentrations were typically 4,000 ppm more in the carbonate shells compared to pyrite rich areas. Although strontianite ($SrCO_3$) and celestite ($SrSO_4$) are present from SEM/EDXS analysis, they are not present in significant quantities to explain high strontium presence in flowback waters from hydraulic fracturing. Because the bulk mineralogy of the sample is 49.5% calcite and 21.8% clay by weight, calcite dissolution could be a key reason behind the high strontium levels from flowback waters (Table 1).

Using molar Sr/Ca values from Figure 26 and the molar Sr/Ca ratio of the seawater they formed in was calculated. This was done using K_d or the ratio of the measured difference in molar Sr/Ca. Using proposed K_d values from Banner (1995) K_d values for calcite (.14) and high-Mg calcite (0.146) resulted in the molar Sr/Ca_{aq} values range from 0.089-0.023 with an average of 0.039 mol Sr/Ca for low-Mg calcite and 0.085-0.022 with a 0.03 average mol Sr/Ca for high-Mg calcite. K_d values greater than 1 indicate that the mineral phase favors incorporation of the trace element (Banner, 1995). With the K_d values being well below this and the Sr/Ca ratios of the seawater values being significantly higher, strontium is going to favor being in a liquid phase over a solid unless the water is enriched in strontium (Banner, 1995). Therefore, strontium is susceptible to being mobilized, especially, in an acidic environment (Stewart et al., 2015).

Table 5: Sr/Ca ratios relation with K_d

K_d Low-Mg calcite	K_d High-Mg Calcite	Sr/Ca calcite	Molar Sr/Ca aq Low-Mg calcite	Molar Sr/Ca aq High-Mg calcite
0.14 (Banner, 1995)	0.146 (Banner 1995)	Max	Max	Max
		0.013	0.089	0.085
		Min	Min	Min
		0.003	0.023	0.022
		Avg.	Avg.	Avg.
		0.005	0.039	0.037

The presence of the strontium ions in clays and carbonates can be explained by the ionic size and charge. The Sr^{2+} ion is approximately 1.18 Å which is within the 15% size difference required for Goldschmidt's replacement for calcium and potassium. The clay matrix can contain strontium for the same reason as it can for barium, in that the matrix has a high surface area to volume ratio. This allows the sorption of strontium ions on folia rather than incorporation into the crystal structure. Unlike barium, strontium is much more soluble, making it more mobile.

Carbonate Crystal Structure Effects on Strontium Accommodation

Upon closer examination of carbonates as a key source of strontium, the crystal structure of $CaCO_3$ needs to be taken into consideration. Aragonite ($CaCO_3$) with its orthorhombic crystal structure and nine coordination number (CN Ca with respect to O = 9) is well known as a favorable polymorph of $CaCO_3$ and can accommodate strontium. Its crystal structure has more space to accommodate larger elements like strontium than does calcite (CN Ca with respect to O = 6 and hexagonal crystal structure). In fact, strontianite is a member of the aragonite group. Aragonite's larger overall crystal structure as indicated by its coordination number creates Sr-O bond distances that are 3.0% shorter than for calcite (Finch and Allison, 2007). This results in strontium incorporation in aragonite causing only a small 2% dilation of the Ca-site versus a 6.5% dilation in calcite, indicating a higher Sr preference for aragonite than calcite (Finch and Allison, 2007). This would make aragonite based carbonates an effective sink for strontium to accumulate, and would explain the high strontium levels in flowback waters from the Utica/Point Pleasant formation. Aragonite although favored biogenically, is naturally unstable under normal temperature and pressure conditions and will recrystallize to calcite unless it is in a high pressure system. The recrystallization process during diagenesis could force strontium into a calcite crystal structure that would be ideal to mobilize strontium, once fluids are introduced via hydraulic fracturing (Stewart et al., 2015).

According to Adabi (2004), Stanley and Hardie (1998), and Banner (1995), an aragonite based sea was not present during the late Ordovician when the Point Pleasant was formed. Laser ablation results support this, as strontium concentrations only reach as high as 4000 ppm which is

not a high enough value for a recrystallized calcite based carbonate from aragonite (7000–9000ppm) (Figure 12) (Swart, 2009; Banner, 1995). Previous studies using sea level height, Mg/Ca ratios, and paleotemperatures argue that calcite seas were present (Stanley and Hardie, 1998; Adabi, 2004). Seafloor spreading in the late Ordovician created lower levels of magnesium and an increase of calcium in the seawater. Aragonite seas show a strong correlation with magnesium levels and an inverse correlation with sea level (Stanley and Hardie, 1999; Adabi, 2004). Therefore, the conditions present during the creation of the Point Pleasant Formation prohibited the production of aragonite.

Magnesium's Influence on Strontium incorporation with Calcite

Although previous research and laser ablation results favor calcite over aragonite crystal structure, calcite structure's is affected by many factors that cannot be ignored. One clear influence is the magnesium concentration relative to strontium. Examination of data in Figure 26, reveals an interesting relationship between Mg/Ca molar ratios with Sr/Ca. The Sr/Ca ratios increase with Mg/Ca ratios until the Mg/Ca ratios reach 0.0425Mol. At this point, the Sr/Ca ratios drop and level out between 0.006 to 0.004 mol. A definite effect can be seen between the amount of magnesium incorporated into the crystal structure and the amount of strontium that the calcite contains. Since larger coordination numbers of calcite (CN Ca with O=6 vs 7 or 8) do not correlate with generating better fits with strontium, the amount of magnesium incorporation into the crystal structure is a significant factor (Finch and Allison, 2007).

Evaluation of geochemical relationships with strontium and magnesium in calcite show a complex relationship with regard to each element's size. Previous studies with inorganic calcite conclude that "the incorporation of small magnesium ions (0.65Å) causes a deformation in the crystal lattice where cations larger than calcium (0.97Å), like strontium (1.13Å) are more easily accommodated" (Wienbauer & Velimirov, 1995 pg. 101). Essentially, the smaller magnesium ions incorporated into the calcite crystal structure cause the structure to shrink in some areas to accommodate the magnesium, which in turn can cause other areas to expand. This distortion allows for larger areas such as the Ca-site to accommodate larger ions like Sr^{2+} (Allison and Finch 2007). In addition to the Ca-site in calcite, magnesium has more than one site it can occupy in the crystal structure. It is magnesium's incorporation into these other sites such as the nano-domains based on Transmission Electron Microscopy (TEM) studies that allow this process to occur (Allison and Finch 2007). It should be noted that magnesium's relationship with strontium concentrations is not always preserved for biogenic calcite. In Wienbauer and Velimirov's study, they claim that high mineralization rates could have been the cause for this distortion, as higher rates reduce strontium levels in carbonates. However, there is still debate among scientists over how much crystallization rates influence strontium levels.

Laser ablation results support magnesium influence on crystal structure as strontium levels reach as high as 4000ppm. This values is within those reported for source rock values containing high-Mg calcite from Swart (Swart, 2015). EDXS analysis did show some carbonate shells reaching as high as 6.47%mol $MgCO_3$, but it was not present in sufficient quantities to suggest high-Mg calcite as a factor for strontium levels (Table 2).

Despite high-Mg calcite's presence from laser ablation its relationship is more complex than simple positive correlations of strontium with magnesium in calcite. It is possible that the magnesium content in the carbonates could be higher due to alteration from diagenesis. However, more magnesium is not necessarily a good thing for strontium accommodation. When observing

Figure 26 it is clear that once the molar Mg/Ca ratio exceeds 0.0425, the strontium levels drop. This could be due to magnesium either distorting the crystal structure too much or recrystallization to dolomite. In SEM/EDXS elemental maps (Figures 10, 13, and 15), magnesium signals were commonly present, indicating dolomitization could have occurred on a large scale. Dolomitization further reduces strontium levels in carbonates because strontium does not fit ideally into the dolomite crystal structure (Allison and Finch, 2007). Therefore, further research needs to be done into magnesium's influence on the calcite crystal structure to understand how this geochemical relationship between strontium and magnesium works.

CONCLUSIONS

The high levels of barium and strontium from fluids associated with hydraulic fracturing are supported by the mineralogical and textural features of sample JP 73 Point Pleasant Formation. Laser ablation results show barium is concentrated in the aluminosilicate clays of the formation due to the high surface area to volume ratio. Based on results reported by Renock et al. (2016), water-rock interactions could cause Ba^{2+} in the clays to exchange with Na^{+} and Ca^{2+} ions during the hydraulic fracturing process due to high ionic strength conditions. The replacement of barium for sodium and calcium was noted from laser ablation results showing inverse correlation of barium with sodium and calcium.

Laser ablation results show that the highest strontium levels are concentrated in the carbonates. The concentrations of strontium in the carbonate structures are indicative of high-Mg calcite. Research on Ordovician rocks suggests that oceans during that time in geological history had high sea levels, high sea floor spreading rates, and lower magnesium levels than present day, in the seawater to support calcite over aragonite seas. Mineralogy of the samples being predominatly calcite (49.5%) had higher magnesium concentrations which lead to a scenario of elevated strontium concentrations. However, influences from other processes like water-rock interactions with subsurface brines enriched in strontium cannot be ruled out. Data are lacking on indigenous basinal fluids in the Pt. Pleasant Formation from eastern Ohio and western Pennsylvania. The high mobility and concentrations of strontium from flowback waters show promise for strontium application as a fluid flow tracer (Haeri-Ardakani et al., 2013).

RECOMMENDATIONS FOR FUTURE WORK

Additional analysis of core samples of the Utica/Point Pleasant formations from wells at different depths, and levels of thermal maturity across the basin must be examined. This should be done so that the results from my study can be compared with other areas to ensure that data analysis from this study is a good bulk representation of the formation as a whole. In addition, other regions should be observed within samples for elemental analysis such as different shell types, grains, dolomite, and micritic carbonate among other areas.

Isotope analysis of the formation could yield more useful information with δD, TOC, $^{13}C/^{12}C$, $\delta^{18}O$, $\delta^{11}B$, and $^{87}Sr/^{86}Sr$. Carbon isotopes can tell us sources and sinks for methane while TOC can tell us source rock quality. Strontium isotopic composition of the subsurface brines could help to identify source of strontium, constrains in water-rock interactions, and may be used to trace the fluid migration pathways. Hydrogen and oxygen data could provide information on the origin and chemical evolution of subsurface water. Boron can help distinguish between marine and non-marine solute sources which might be useful for source indication. Isotopic evidence could reveal some interesting results and have not been done extensively in the Utica/Point Pleasant formations.

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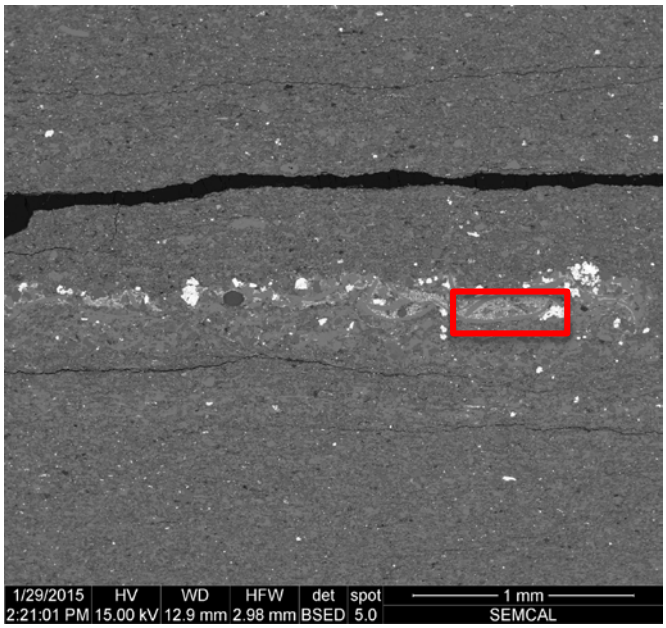
APPENDICES

SEM Images of Laser Ablation sites

Site E



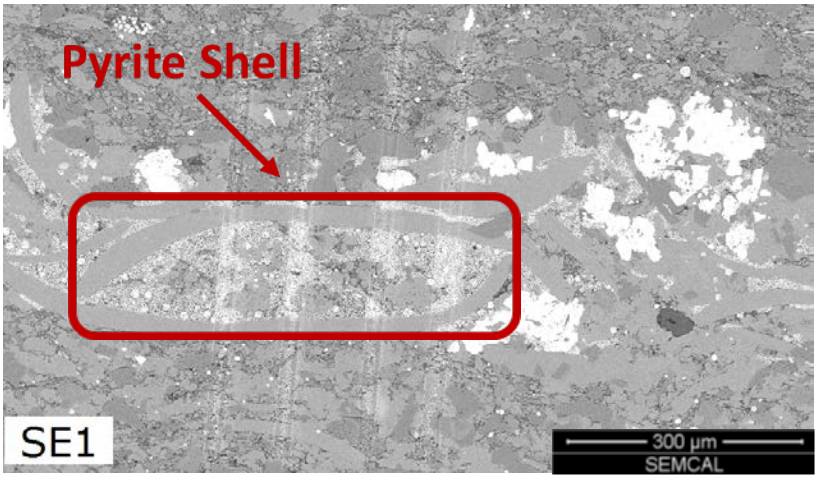


Figure 1: SEM images of Laser Ablation Site E

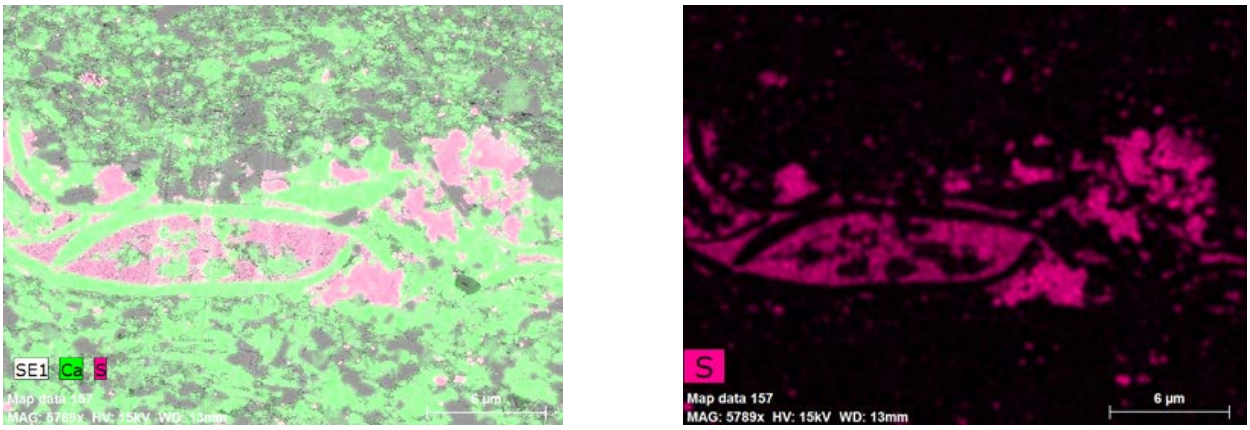


Figure 2: **Elemental maps of laser ablation site E**

Site B

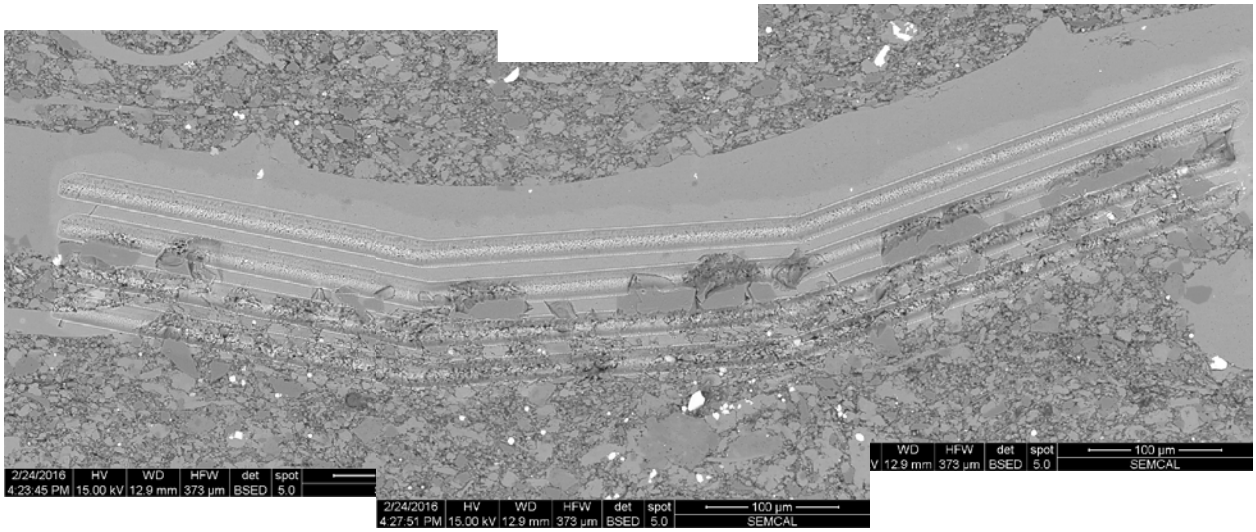
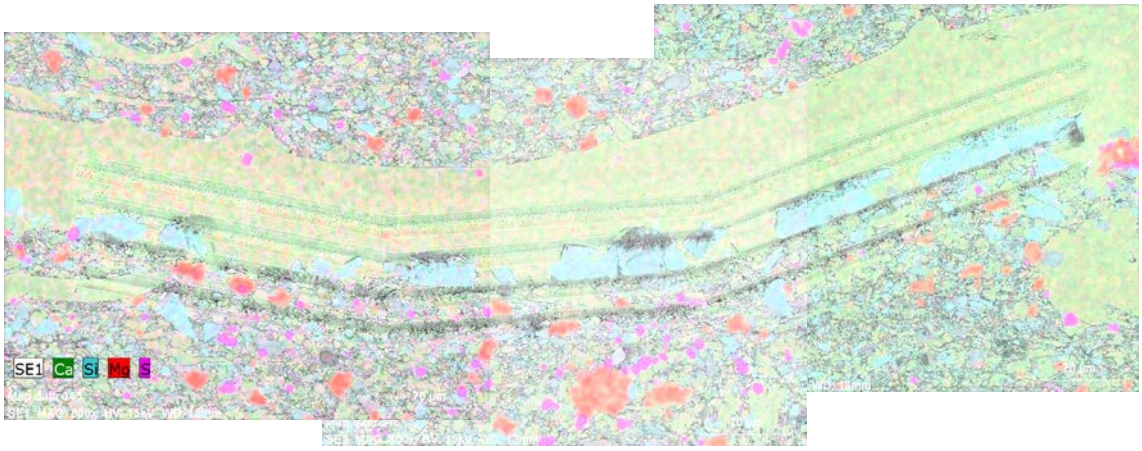
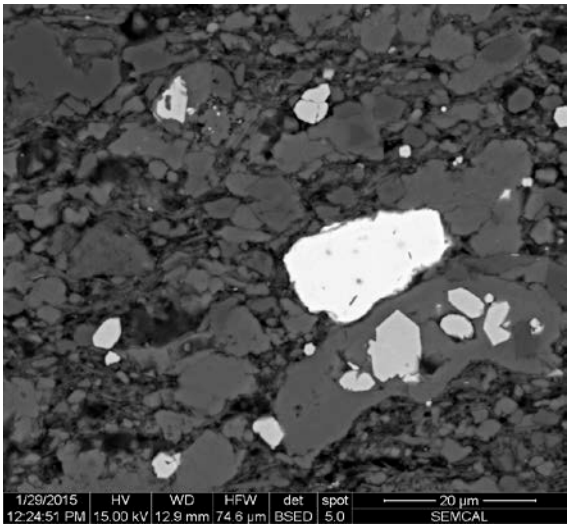


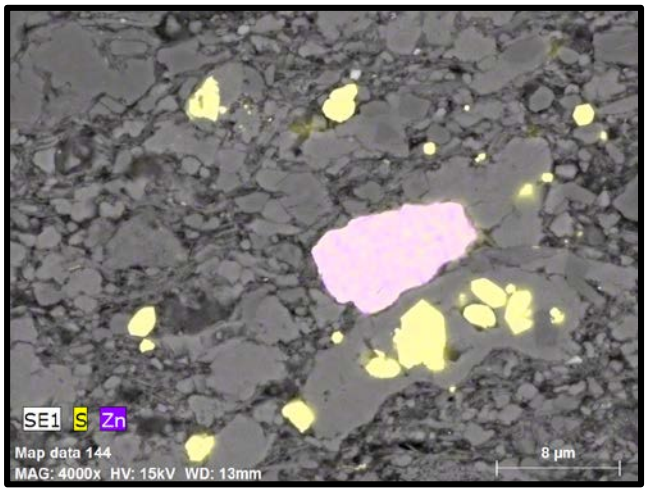
Figure 3: **SEM BSE image of Site B**



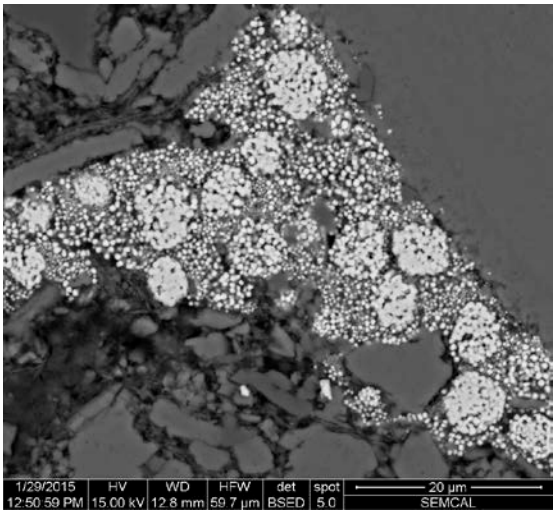
<u>Figure 4:</u> Elemental maps of laser ablation site B

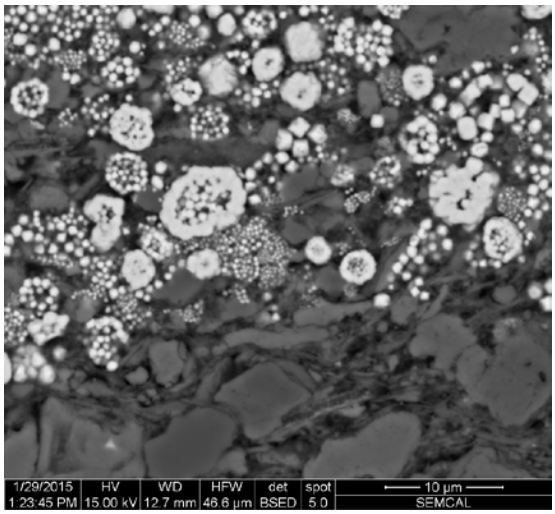
Other Mineralogical Images





<u>Figure 5:</u> SEM image and Elemental map of a Sphalerite mineral





<u>Figure 6:</u> SEM Images of Pyrite framboidal structures

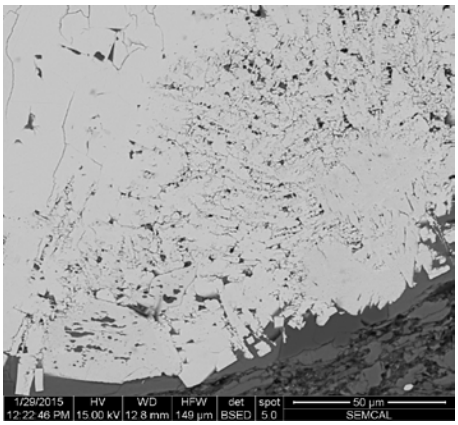


Figure 7: SEM Image of pyritohedron structure from bowtie carbonate

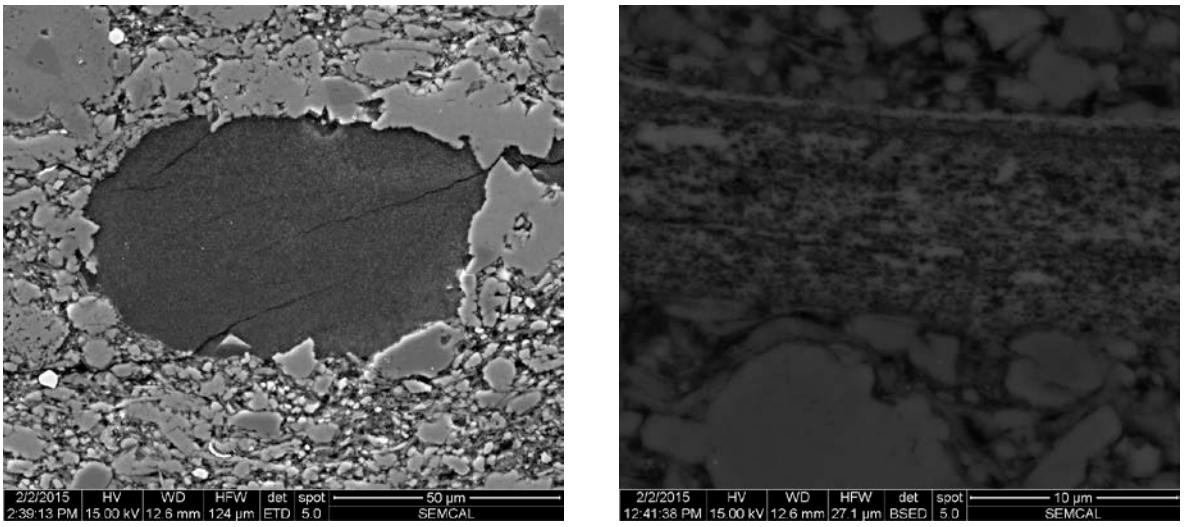


Figure 8: SEM images of Ca-phosphate structures with different textures

Laser Ablation Raw Data

		Mg24(LR)	Ca43(LR)	Sr88(LR)	Ba138(LR)	Al27(LR)	Na23(LR)		Mn55(LR)	Ni58(LR)	Zn64(LR)	Rb85(LR)	Sr88(LR)	Mo98(LR)	La139(LR)	Ce140(LR)	Th232(LR)	U238(LR)
	Ave net signal	121,763	75,818	356,626	325,537	2,224,106	51,901,429		1,092,207	511,686	413,373	1,454,630	1,578,339	323,729	1,317,153	1,702,166	1,335,839	2,275,608
NIST 610 End																		
	Ave net signal	227,869	130,332	605,362	547,681	4,075,508	88,951,114		1,714,247	861,030	565,677	1,983,331	2,089,212	452,513	1,621,539	2,039,395	1,743,885	2,955,042
NIST 610																		
	Ave net signal	44,426	131,214	95,761	52,654	4,435,973	118,242,940		198,410	115,718	91,706	236,832	327,288	63,635	133,123	230,714	138,730	388,392
NIST 612																		

Table 1: NIST 610 and 612 standard data from Sites A, B, C, & D

Bowtie Carbonate

		bowtie carbonate major						
Ave blank		**21,292**	**4,157**	**45,682**	**7,579**	**13,047**	**44,199,386**	**3,253**
Trace for Mass:	Distance (um)	Mg24(LR)	Ca43(LR)	Sr88(LR)	Ba138(LR)	Al27(LR)	Na23(LR)	Ti47(LR)
Resolution:		Low	Low	Low	Low	Low	Low	Low
Time [sec]	10 um/s	Intensity [cps]	Intensity [cps]	Intensity [cps]	Intensity [cps]	Intensity [cps]	Intensity [cps]	Intensity [cps]
0.95	10	22477	4455	49160	7892	16418	44558972	3186
1.83	18	21201	4261	48520	8083	13708	45378668	2866
2.71	27	21838	4517	48010	7447	14186	45282820	3343
3.59	36	22476	4455	47247	7828	13547	45024580	3343
4.47	45	21681	4262	47056	7828	12910	44910212	3502
5.35	53	20402	4326	46546	7574	12751	44708544	3025
6.23	62	21360	4262	46865	7574	13709	44688396	3661
7.11	71	20724	4006	47438	7383	13390	44463936	2865
7.98	80	20883	4326	46039	7510	13229	44361984	2549
8.86	89	21999	4134	45528	7256	13070	44268780	3661
9.74	97	21681	4070	45783	7638	13390	44078100	3345
10.62	106	22158	3816	44889	7892	12115	44036584	3025
11.50	115	20561	4261	44444	7638	12433	43835528	3184
12.38	124	21361	4006	43808	7256	14027	43763896	3345
13.26	133	21679	4070	45401	7765	12913	43550628	3343
14.14	141	20563	4135	44191	7956	12272	43571996	2865
15.01	150	20563	4070	44318	7002	12910	43528244	3824
15.89	159	21520	3752	43999	7765	13709	43435040	3184
16.77	168	20883	3943	43174	7892	12911	43374600	2865
17.65	176	19926	3879	43872	7320	12274	43331460	2547
18.53	185	20722	4006	43365	7129	13388	43155840	3663
19.41	194	21201	4070	43555	7129	12433	43173744	3345
20.29	203	20722	3879	43299	7638	13229	43088480	3186
21.16	212	20084	4261	44001	7321	12911	42929952	3025
22.04	220	1368054	237971	1744631	213708	6251800	43956612	35708
22.92	229	4129041	364375	1737502	351894	16474648	46070164	80667
23.80	238	4965909	310630	1878165	306427	15401185	44892912	85292
24.68	247	3447494	610173	3813641	134873	5978525	44119412	41129
25.56	256	5145243	827126	5166992	189637	2150830	44482864	30927
26.44	264	4426888	286049	1516972	331197	17888972	44851604	110480
27.32	273	3533116	187726	938955	335977	23180482	46233168	146356
28.19	282	2876600	124938	632526	403666	21012698	44391696	91670
29.07	291	3306544	176455	1359367	333044	23006082	44472484	214432
29.95	300	5335109	291460	1566333	362400	17941374	44910620	109206
30.83	308	5148271	148752	1000279	393984	22328326	45572808	126106
31.71	317	3196069	284140	1785579	427927	18013616	46272440	91670
32.59	326	3700673	263952	1461448	346159	19880628	44805208	91670
33.47	335	4901120	215427	1062747	259113	16931098	44724824	106497
34.35	343	6526856	434231	1879246	219887	13403884	49132224	65522
35.22	352	5947339	454546	3115662	278471	16489707	45296660	74769
36.10	361	4549141	225553	1145273	341385	20885714	44753924	150660
36.98	370	3014802	119079	882592	352723	23141004	44659296	199444
37.86	379	3458991	158306	1430045	327886	26070690	46637316	122598
38.74	387	3991576	346098	1905294	290250	15659427	45067516	56276
39.62	396	2687154	243766	1492838	338966	18095322	50152576	68233
40.49	405	3599750	399208	3026198	246694	11098788	46426488	345006
41.37	414	3692711	265924	1240409	316422	11155361	44639556	102033
42.25	423	3070434	206576	1357898	244847	18865876	44548796	93585
43.13	431	2511165	243512	1297211	215109	13551981	47342240	60102
44.01	440	1362636	138693	1064591	325341	12094819	51995472	58508
44.89	449	1531789	88896	1370891	430539	16333317	46582984	53088
45.77	458	2560107	187282	1316378	412895	21302584	45884776	88321
46.65	466	3883035	284519	1763601	271911	16410444	44384164	65840
47.53	475	3567877	479570	3044945	192948	13610233	43662148	63290
48.40	484	3621092	534143	4290086	251280	6795298	43338580	32204
49.28	493	2811035	422514	2846673	193584	2468748	43444400	9563
50.16	502	2099993	302599	2365688	122771	445284	43472280	8286
51.04	510	816754	103923	907432	66033	318379	44556732	4779
51.92	519	413235	49668	546372	30139	166123	44646272	4460
52.80	528	194982	35787	447473	14007	27740	45091736	4302
53.68	537	95338	27126	298593	18401	21520	44962920	3025
54.56	546	64088	18654	171424	8784	23274	43103132	3504
55.43	554	41449	8528	76476	8083	18650	42838176	3665
56.31	563	73654	10504	63104	8657	19608	43216280	3186
57.19	572	56276	16426	297830	36613	18811	42316604	3824
58.07	581	2172388	312028	2495165	124938	29492	42895968	3983
58.95	589	6619168	679906	4297717	210460	412283	43599876	4460
59.83	598	6780620	604570	2687650	142132	3489084	43719940	21840
60.71	607	3884179	217020	1242965	280254	14891825	46236420	425035
61.58	616	2832402	202182	1154952	292862	17220170	45206100	182226
62.46	625	2773413	252998	1323838	190975	17255478	47167028	84972
63.34	633	2263416	187536	1192586	250578	25333716	59966160	93263
64.22	642	3070764	258475	1430109	231920	21722404	51502392	93104
65.10	651	3620659	366159	2720185	535354	14444328	46763688	65684
65.98	660	3861031	218802	1475146	388827	18480852	47320464	80351
66.86	669	3485281	196449	1117698	226635	19364450	48248832	104424
67.74	677	11368019	171805	1008432	432195	15392333	43905736	1277662
68.61	686	21116688	295538	1417816	296046	15314291	43333088	244243
69.49	695	24611188	284010	1619250	479821	9531075	42908588	85770

70.37	704	5275102	260067	2590301	341640	16660545	45619816	51174
71.25	713	4456498	600182	4843071	260194	9889184	42882944	58190
72.13	721	3534859	452571	4668087	589991	13627022	43638540	101874
73.01	730	2238856	243764	3850169	880052	10892134	44291980	70465
73.89	739	3251523	379022	3395945	331134	12203641	43774680	54840
74.76	748	3643566	492880	2663739	179511	9600774	45887012	65524
75.64	756	3551749	373797	1514422	216065	14168891	45734184	77001
76.52	765	3669118	391693	3045238	259812	17078228	47056936	54522
77.40	774	4703597	285921	1750094	350810	14197737	55463520	73494
78.28	783	17878900	291905	1555223	343807	14555338	45290552	116381
79.16	792	12243679	285854	1322877	414169	19098780	44004636	82104
80.04	800	4249436	289485	2111682	387300	18976478	44337360	123876
80.92	809	4267065	414169	2296409	405000	15942902	42969432	83378
81.79	818	2987533	235742	1239455	410094	18939948	43763488	49738
82.67	827	4982647	278598	1795442	233895	15133379	44379688	53565
83.55	836	30310512	438434	1379488	135510	8882164	42677208	28217
84.43	844	40363412	413086	1258228	314257	9482642	42153804	47187
85.31	853	11803967	335589	1383571	379721	19461010	43268780	102671
86.19	862	4010426	256375	2280307	450660	14439241	43675780	79076
87.07	871	3949859	323236	1691314	271722	17458368	43901260	78915
87.94	879	7669441	235931	1381721	205939	20073342	44995888	81945
88.82	888	2588495	115130	717156	247394	20863024	54466776	88801
89.70	897	3427067	202564	1140815	236058	18572122	52078092	126587
90.58	906	3555578	227464	1176923	235996	17139482	47027832	95017
91.46	915	9096094	272485	1297217	199190	12793384	43874396	101713
92.34	923	13917111	198107	849231	126529	13809256	52348136	287769
93.22	932	6347013	90295	504661	137990	24203374	81925032	113035
94.10	941	6964228	152639	855279	204920	18256596	57388220	64567
94.97	950	3139776	82335	393159	202564	22938112	59456188	96613
95.85	959	2780090	78705	476893	311202	29765742	58539624	478130
96.73	967	3160024	200463	1036572	391881	26482066	46044112	144919
97.61	976	3121766	316996	2168865	282290	19654946	44171912	109208
98.49	985	2634715	213580	1505442	333297	22839008	45237032	112714
99.37	994	2576844	247076	890879	351254	19345320	44006876	82422
100.25	1002	2746780	219375	1494110	416019	18768092	45332068	63451
101.13	1011	2033181	139776	929537	165822	9867410	48178624	40493
102.00	1020	2204732	62657	537075	133024	15344918	49531288	32734
102.88	1029	2499362	25596	290377	158369	17273894	47670280	9243
103.76	1038	2757489	29735	356478	116024	19396704	48221564	14984
104.64	1046	1919666	17317	244402	94882	13566022	46548388	6692
105.52	1055	2854100	19420	255417	174991	21273382	49878868	8447
106.40	1064	2062040	13242	176582	106979	15191886	46451928	4940
107.28	1073	3005237	12032	180468	102140	21404232	47052048	6851
108.15	1082	2387742	11841	179322	83864	17827008	45300320	8925
109.03	1090	3096927	8275	133025	86155	10895238	44852012	7331
109.91	1099	2187536	10248	191230	105133	14767079	46273052	8129
110.79	1108	2255581	25787	232430	80169	15367608	46303576	10838
111.67	1117	1718163	83036	852220	141941	11063227	47242320	13070
112.55	1125	2489785	195940	1429149	276814	15415430	48048384	66160
113.43	1134	3366501	226763	875336	312217	21413694	44521324	105699
114.31	1143	4871841	260195	1176160	283501	22068558	44319044	127701
115.18	1152	6527186	194730	875721	278980	18074972	43465568	111119
116.06	1161	3062955	226507	2378177	2481021	18831484	43190432	181589
116.94	1169	3397725	186899	3647305	3308834	30178338	43079528	405747
117.82	1178	3944085	199508	1883393	620039	25281416	43156448	1057005
118.70	1187	6034360	428562	4134968	3037772	13015860	43591940	300525
119.58	1196	6085998	278789	2227066	1843519	14267182	44740492	88642
120.46	1205	25292812	295918	938052	326168	13462136	42494872	68711
121.33	1213	48899828	412261	863113	120351	6782401	41323320	47028
122.21	1222	63495868	366475	463842	48331	3440638	41352216	44636
123.09	1231	6969265	42978	105133	14962	622567	40845504	6852
123.97	1240	1347183	11905	52978	8720	162139	40549616	3663
124.85	1248	345481	6684	45210	8657	71421	40539848	3345
125.73	1257	187487	4582	42024	7892	32043	40433824	3983
126.61	1266	72379	4453	40307	6874	36188	40391696	3186
127.49	1275	58827	3881	39288	7512	21201	40342856	3024
128.37	1284	34754	3943	39352	6747	17693	40391496	3343
129.24	1292	20086	3943	39350	6429	22956	40268988	3504
130.12	1301	22636	3816	39350	6493	17374	40284452	3504
131.00	1310	26143	3816	37697	6493	19606	40394140	2708
131.88	1319	19608	3816	38905	6175	19288	40294424	3504
132.76	1328	20720	3943	39417	6429	16738	40278144	3663
133.64	1336	19445	3817	38142	6493	16099	40180056	2865
134.52	1345	20084	3816	38841	6493	18331	40260848	2706
135.39	1354	20245	4135	39034	6175	16895	40315588	3822
136.27	1363	20563	4070	39034	6684	17056	40152788	3024
137.15	1372	20084	3816	39225	5919	16258	40203460	3663
138.03	1380	19286	3752	37568	6493	16418	40219740	3822
138.91	1389	20404	3752	38396	6493	19606	40205496	4302
139.79	1398	22953	3498	38142	6557	16417	40131016	3186
140.67	1407	19447	3752	38396	6364	17375	40040864	2708

Table 2: Bowtie carbonate raw data Major elements Site D

bowtie carbonate minor

Ave blank		**61,752**	**31,500**	**30,131**	**52,735**	**134,022**	**658**	**751**	**57**	**665**	-
Trace for Mass:	Distance (um)	Mn55(LR)	Ni58(LR)	Zn64(LR)	Rb85(LR)	Sr88(LR)	Mo98(LR	La139(LR	Ce140(LR)	Th232(LR	U238(LR)
Resolution:		Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Time	10	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity
[sec]	um/s	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]
0.90	9	63301	33599	31793	58985	144688	601	1301	0	500	0
1.73	17	66712	31694	32496	52062	140018	1402	1603	100	300	0
2.55	26	62296	30990	28683	51057	138467	1000	1202	0	1301	0
3.38	34	65208	31592	27981	54871	138984	401	902	0	400	0
4.20	42	60892	33700	29084	58082	136915	600	800	0	300	0
5.03	50	62297	30691	31393	53366	136393	1102	600	100	1501	0
5.86	59	66412	28985	28484	51961	138472	500	1202	0	200	0
6.68	67	65709	34603	32596	53767	133796	500	801	0	600	0
7.51	75	61294	28182	30390	52161	133279	901	1101	100	300	0
8.34	83	59085	31993	32495	51660	134314	300	600	0	701	0
9.16	92	57781	32998	29887	50656	134319	1302	900	100	901	0
9.99	100	61896	31192	30089	48148	130171	400	600	200	700	0
10.81	108	62296	32095	28182	52461	135876	1201	801	0	1301	0
11.64	116	60591	34101	29988	53567	129649	200	701	200	801	0
12.47	125	64003	26576	28784	53566	134314	400	500	0	600	0
13.29	133	55172	32596	31392	51459	130171	901	701	100	600	0
14.12	141	61895	31693	31091	52563	129654	500	300	0	400	0
14.94	149	60188	29787	32396	50355	128097	600	601	200	400	0
15.77	158	60691	33398	31693	54069	125496	500	1101	0	1301	0
16.59	166	59286	32094	31794	51459	130166	300	400	100	801	0
17.42	174	60088	29988	32194	51660	131205	901	1302	0	1001	0
18.25	182	64204	29687	31191	52663	128097	800	400	0	300	0
19.07	191	56576	33900	30289	49753	131205	600	1001	100	200	0
19.90	199	65106	28483	30489	51659	130688	300	800	0	701	0
20.72	207	56074	30992	31092	54270	127057	500	1101	100	500	0
21.55	215	68720	39317	40020	126869	792471	1101	13437	91517	12233	28484
22.38	224	1019668	808732	163223	421488	6782754	10327	33198	155804	18652	18251
23.20	232	912976	437922	160910	544688	4161678	4913	20859	116970	38215	54371
24.03	240	792060	249084	82170	440660	3077044	3006	93216	200512	23166	21562
24.85	249	892852	448414	89299	587798	3079924	2305	42127	117213	19153	17750
25.68	257	393194	206645	81871	281583	1411606	2004	20559	78358	10829	5915
26.51	265	506712	173674	261784	367366	456116	2103	68319	143127	10730	13236
27.33	273	618616	224041	400603	437540	1592712	5313	110693	218464	10829	7820
28.16	282	928352	182022	175254	342198	9163557	2104	64404	151669	12534	8121
28.98	290	967984	220873	85012	389240	1768106	1904	79260	171260	12132	9825
29.81	298	645672	224347	63703	491882	3078998	1703	36108	98235	16045	11431
30.64	306	584504	336329	58283	581750	4363031	2104	32695	108376	26276	24671
31.46	315	648232	334434	64003	475158	5499428	1804	97832	219517	21561	23370
32.29	323	777224	265380	66211	472222	4170656	3508	53465	153980	23868	24169
33.11	331	772360	205468	60892	358208	10851060	1602	94429	279711	14540	18854
33.94	339	841808	268397	72936	489262	9131649	1903	75445	168248	20057	20257
34.76	348	657484	387111	65409	711574	3183397	2304	35505	91106	15844	37312
35.59	356	644932	163322	88596	616830	4627256	1403	34001	120326	39321	39619
36.42	364	778184	235304	65209	492082	11009700	10428	71028	173676	21663	12634
37.24	372	2012840	1084572	74241	397802	6164204	24872	26477	64512	9725	6016
38.07	381	2707808	1529040	87092	434890	6015377	19354	32495	108577	9425	11431
38.90	389	990804	453062	83777	607100	4895500	4411	40221	159303	37211	21866
39.72	397	708120	230195	73438	480580	4481048	3507	95123	237213	32395	18853
40.55	405	795984	378596	118420	680444	4191765	3608	54571	150764	19154	12734
41.37	414	947652	499962	97631	583960	5520808	1401	84379	280821	68768	38716
42.20	422	833904	209865	69924	446694	6093401	1502	53165	152571	26376	24771
43.02	430	1399016	235504	67616	460722	6057531	2705	68420	151164	17047	13637
43.85	438	1830928	354291	58082	518858	5590518	2305	40623	103756	14540	12534
44.68	447	1832397	336650	69322	652186	2762393	3708	28582	233620	14038	11531
45.50	455	4317872	509544	81769	305938	4775021	1503	42731	98636	11230	12735
46.33	463	5828448	417350	61594	335240	3345066	2304	33900	113297	11933	12433
47.15	472	2200128	570008	102150	415844	3956851	3708	17750	57079	11331	13137
47.98	480	2171312	779060	134186	398908	2929198	3908	33098	130776	13338	15744
48.81	488	1145360	447926	93615	552452	2865135	2405	34102	131592	28884	77554
49.63	496	781892	232086	67316	531740	4237820	3709	38214	106468	22364	25374
50.46	505	1594568	417046	81268	394386	3520035	6216	47244	138808	18351	12835
51.28	513	2291672	1452768	76148	315906	4346814	5312	34904	96628	14038	9425
52.11	521	1345408	4201488	89501	164330	4803576	15043	28984	75546	6818	4110
52.94	529	477048	7854848	122037	90805	4087892	43330	11932	58586	1803	3007
53.76	538	336583	8336844	193819	55072	6262024	75646	13738	41424	1503	801
54.59	546	168045	10983680	126252	60994	2511235	52060	6216	21460	1101	1604
55.41	554	114702	8639514	112894	60792	2406970	32696	4409	18151	1301	1503
56.24	562	133287	10575040	77653	66112	1812111	9124	3307	9224	901	100
57.06	571	79862	10312320	78658	65914	551824	6215	3107	6617	200	902
57.89	579	102551	10607808	81969	56177	2453641	7218	3207	22363	1302	100
58.72	587	312209	8902016	79460	50154	7093330	11632	7319	43130	701	200
59.54	595	267921	8801344	81970	97204	3930211	5113	4411	16445	2605	2305
60.37	604	113502	10702272	71831	49954	1139437	2203	3607	9525	801	0

61.19	612	302337	7192192	128012	50556	8163826	2003	25474	77955	3809	4911
62.02	620	1142888	1513632	69223	56377	15425262	7218	60491	154682	6616	5112
62.85	628	4667936	794184	110253	115104	9281985	3608	45137	132277	11631	22064
63.67	637	4064400	714828	96225	394682	4812572	10829	52864	204587	15442	10930
64.50	645	2153304	1319448	109782	328512	7324966	21260	26477	74141	6015	4911
65.32	653	1597216	1031484	91207	301922	9087877	6517	27579	96529	8724	9125
66.15	662	1274800	464284	105563	386112	5628997	3508	110487	281793	19856	14640
66.98	670	700712	337466	83275	537498	3924052	1903	152816	223133	23065	18953
67.80	678	904484	210866	83178	503696	4755436	4309	143531	479694	14441	14740
68.63	686	860124	262374	80766	525696	6314659	3709	60691	133585	12434	9325
69.45	695	1116076	394026	79763	520044	4219046	4209	64805	162218	21461	12234
70.28	703	1458472	1363576	119122	449916	4921225	11131	30188	118720	19355	15844
71.11	711	751720	563334	73438	613556	3330137	2404	89865	143329	14239	22163
71.93	719	802148	265024	62598	445614	5275533	1503	34101	118319	14942	15744
72.76	728	1099304	409643	64404	457784	5134623	6316	38013	101046	16246	28785
73.58	736	543764	480478	91608	494116	5147700	4310	39016	155306	23969	17448
74.41	744	894600	292810	91007	531270	5067281	3007	47847	158403	22765	13236
75.24	752	999204	401056	78257	431260	6751871	5613	48650	139917	13637	11631
76.06	761	1616944	291556	63300	342084	16525077	1504	95636	245260	19255	10728
76.89	769	1166888	240434	63802	483006	6279681	2706	111690	230579	24068	13738
77.71	777	1437624	806760	96535	509558	5223599	5513	60492	176791	25276	14139
78.54	785	757084	399340	63200	451328	5512908	8823	228993	571814	28082	15243
79.37	794	602948	224166	195706	479614	5495916	3407	75449	171765	20860	10829
80.19	802	854452	298512	68519	437416	4809118	2505	64103	172794	18352	14340
81.02	810	833248	546644	75347	559740	3784725	8020	25875	89805	7519	9627
81.84	818	960732	530646	85486	384232	7958247	3106	50254	200348	10629	8823
82.67	827	887692	217015	68921	301641	8634658	1603	59391	165733	9727	10429
83.50	835	723824	259594	73441	414242	6546258	6517	48749	188673	34702	28283
84.32	843	700376	2904720	121732	280572	6727377	36307	159407	598016	114199	40923
85.15	851	430076	5641440	167446	208862	10338058	41525	345006	1281048	252410	64003
85.97	860	600844	2399544	134293	296478	8528725	11430	162320	573776	67315	27180
86.80	868	873552	451046	92410	431272	4156547	4610	45839	178904	23768	10028
87.63	876	439038	279992	96631	381788	3183107	2806	23669	104561	14039	8723
88.45	885	409194	154586	85785	205843	2082828	1101	24972	116713	7921	7519
89.28	893	671300	104561	90206	194982	4458674	2205	38214	182225	15644	9625
90.10	901	721152	216883	302585	522802	3645742	3508	53065	170563	18853	14339
90.93	909	979676	226762	293624	480174	4596414	2205	47545	124445	26076	26077
91.75	918	1583392	378068	108977	473764	7337719	6315	43532	101650	13536	15744
92.58	926	2183968	490944	93717	390248	9775978	4309	32596	110689	12735	12335
93.41	934	1017332	213881	87391	454454	5787048	2806	37813	147077	14439	10228
94.23	942	783824	181211	104165	707932	5276057	2605	36911	142825	19455	19556
95.06	951	621884	215796	88997	577402	4300718	3307	49554	121234	44937	67114
95.88	959	542500	155587	96230	427430	3088478	2806	41928	119528	77352	188757
96.71	967	407820	117715	69824	340980	1415873	1903	18353	91649	15042	28383
97.54	975	303928	173370	89903	531466	1448027	1302	19956	99150	14238	11933
98.36	984	645300	484272	92310	414970	2069366	1201	25072	67415	11933	11733
99.19	992	1549352	497036	87993	435400	3372699	4811	19957	60591	9826	11732
100.01	1000	1160956	223638	82874	361526	1866871	2004	22364	96631	15242	13337
100.84	1008	633160	272937	113800	423298	4173175	901	28383	96427	7419	6517
101.67	1017	1013238	1176812	352976	525082	4789619	5613	41324	148051	14439	14340
102.49	1025	805076	800836	280981	438628	7194851	26677	82885	208661	18852	22163
103.32	1033	1266724	3277408	363460	302346	6133280	47143	33399	93917	7119	9726

<u>Table 3:</u> Bowtie carbonate raw data minor elements

Left Hook Carbonate

		Left hook carbonate major						
Ave blank		**20,873**	**3,809**	**37,639**	**6,375**	**17,416**	**38,314,798**	**3,616**
Trace for Mass:	Distance (um)	Mg24(LR)	Ca43(LR)	Sr88(LR)	Ba138(LR)	Al27(LR)	Na23(LR)	Ti47(LR)
Resolution:		Low	Low	Low	Low	Low	Low	Low
Time	10	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity
[sec]	um/s	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]
0.95	10	21921	3920	40402	6520	19047	37381592	3777
1.83	18	21619	4165	40221	6942	18444	39337840	3928
2.71	27	21921	4041	39312	6640	18444	39106048	3474
3.59	36	20562	3801	39737	6821	17537	39060884	3174
4.47	45	21317	3800	39616	6761	17839	38897992	3472
5.35	53	21317	3922	38589	6701	18140	38721204	3626
6.23	62	22679	3862	37985	6098	17837	38704220	3472
7.11	71	20713	3922	37744	6279	17084	38587840	2568
7.98	80	19804	4041	37502	6339	17687	38392524	4231
8.86	89	21467	3800	37080	6339	17387	38273252	3928
9.74	97	21165	3862	38288	6399	17385	38177908	3323
10.62	106	20259	3801	37080	6520	17688	38070216	3626
11.50	115	20862	3619	37563	6098	17536	38100904	4229
12.38	124	21922	3981	36537	6640	16933	37931640	3777
13.26	133	19653	3560	36295	6158	16631	37912728	3172
14.14	141	19956	3558	36960	6399	17084	38099744	3929
15.01	150	21014	3741	36960	6098	17234	37948432	4229
15.89	159	20410	3860	36656	5977	17234	37842476	3476
16.77	168	20108	3679	35752	6339	17385	37804840	3928
17.65	176	20561	3739	36356	6339	17687	37726676	4079
18.53	185	21165	3558	35931	6218	16780	37711620	4382
19.41	194	20410	3800	35628	6037	16782	37666844	3323
20.29	203	20107	3679	35569	6037	17233	37536956	3779
21.16	212	20108	3498	36536	5977	17537	37463036	4382
22.04	220	995524	116076	1072356	196762	4051492	37953836	27667
22.92	229	3236490	246348	1330482	289711	14128565	39250216	48232
23.80	238	3151220	273525	1213258	202318	9951756	39152172	68945
24.68	247	3054141	358559	1518964	171880	9947702	39282256	83613
25.56	256	3907695	358439	1733852	243087	12458488	39010512	50500
26.44	264	2941200	252688	1469876	194105	12263124	39109712	67434
27.32	273	3136841	415270	2439375	228892	7946582	38255108	84370
28.19	282	3787649	346239	1917793	202501	7112726	38647480	67735
29.07	291	4114977	304990	1380010	224001	11540724	38628756	258255
29.95	300	3412807	303661	1616080	225389	11676210	39206792	128521
30.83	308	4266651	323593	1812722	201775	9162627	39481240	42486
31.71	317	23304364	309883	984306	87871	8170848	38246232	30087
32.59	326	32122340	321720	927829	159379	3930807	37673792	37344
33.47	335	21038736	290678	1120365	187643	9983794	38454864	153319
34.35	343	7018855	188489	866832	144462	9613909	38793772	45509
35.22	352	3565663	146816	779141	143253	10311122	38907640	41881
36.10	361	1896696	168800	1378129	172847	8779715	40076064	69249
36.98	370	1809279	330054	1647605	260963	7133907	38937556	42332
37.86	379	2411704	419136	1697134	209687	8826276	38135064	113098
38.74	387	2832794	267908	1522414	252025	11337254	38832760	556579
39.62	396	2582859	211922	1005681	270203	17073744	38624124	752842
40.49	405	2539916	285423	1739660	235113	13406070	39063200	167078
41.37	414	3006216	251541	1428749	211558	11268932	38424948	74994
42.25	423	2508168	177195	978320	179489	14021546	44487272	60026
43.13	431	2130286	136308	498070	110761	20380510	54657020	48684
44.01	440	710505	69510	405662	110336	12300180	45353648	30238
44.89	449	1706627	130629	1448127	461167	14113897	39133260	145002
45.77	458	11757126	260600	1376440	201653	10676422	38896448	102515
46.65	466	30802220	273585	1079419	117342	4859981	37645228	32204
47.53	475	24542844	318216	1336700	219774	8702177	38195472	62597
48.40	484	10124394	292850	1597907	230947	10511648	38546924	61991
49.28	493	5244341	358017	2083833	237832	8406549	38108236	42032
50.16	502	5032041	361037	1397754	195313	8422038	38106884	32052

51.04	510	2744183	285604	1095975	170309	10316767	39536436	44300
51.92	519	2450678	211982	1337611	220922	14976752	43956520	139256
52.80	528	2757644	168739	783860	211983	14509740	38627408	104478
53.68	537	2572268	173512	888997	197608	14098505	38561592	100701
54.56	546	2472463	206124	1287594	266458	13194493	40387180	94954
55.43	554	2873625	230827	956279	216873	12959612	38755364	68643
56.31	563	2384009	187160	953504	275217	12908757	37943220	72726
57.19	572	4039526	217781	1028871	210292	14255993	37946696	65014
58.07	581	9240164	190845	628037	140899	11265844	43571872	52314
58.95	589	11599445	166263	926626	229194	12579354	45308100	63201
59.83	598	6116942	322865	1851558	165962	9133387	38598648	47021
60.71	607	4188945	423965	2371970	153218	7214147	38837196	47021
61.58	616	3854934	311635	1680451	229920	11784194	41437100	56246
62.46	625	3813632	307345	1795690	172544	15124445	40124508	41729
63.34	633	11443501	241273	1116445	207695	13784542	37795384	114761
64.22	642	6283091	233120	982611	234631	13680033	37654300	106595
65.10	651	3292604	216089	1003624	245137	15714542	40942056	74843
65.98	660	2412295	188370	1009607	202923	15032577	38878884	107504
66.86	669	3049774	213553	1649306	173570	12562563	38434408	110830
67.74	677	3679666	327337	1340928	146574	9039638	37678040	60932
68.61	686	2075703	168620	602009	164329	9993250	38035476	111584
69.49	695	1580978	112632	393345	216751	15894418	38510640	80137
70.37	704	1812777	121148	679432	266337	16935172	38182736	80893
71.25	713	2419858	121329	728053	211318	15402751	38655392	192027
72.13	721	2090829	157568	594880	407115	15958977	42154480	92836
73.01	730	2931972	80504	402827	406511	25397738	40629396	93290
73.89	739	3435798	163666	1039016	289589	20005512	39947912	270655
74.76	748	2547612	239944	1311640	269960	13739139	39799304	128368
75.64	756	2525538	344006	2376011	152675	8567125	37850196	61840
76.52	765	2017200	286689	1385318	65284	2875423	37214452	31902
77.40	774	1657647	268994	1439611	39132	1008371	36651088	25398
78.28	783	1502819	430429	2637032	36777	1421162	36495336	12093
79.16	792	1657490	512620	3272158	28564	992195	36476616	18594
80.04	800	1735348	562327	3535398	59727	872589	36236908	7406
80.92	809	1720848	608288	4273213	28443	1212046	36224556	9220
81.79	818	2028539	622241	4387252	38650	1208560	36423344	5743
82.67	827	3518185	626948	4572990	54171	536166	36592220	5894
83.55	836	3011343	653103	5760302	38226	457540	36440524	5743
84.43	844	2031410	693690	6006426	20953	284111	36084632	4382
85.31	853	1602437	703591	6598139	18418	120961	35962848	4382
86.19	862	1712362	702019	6183720	19083	69097	36023644	4683
87.07	871	1536226	715611	6437250	20894	45358	35944320	4231
87.94	879	1539241	666327	5997644	20470	151202	35985428	4231
88.82	888	1529266	731551	6605280	18718	65620	35869436	4380
89.70	897	1601243	718026	6678572	20894	46870	35940652	3928
90.58	906	1927986	709510	6972511	33395	74843	36002800	4836
91.46	915	2599650	684689	6163431	74766	223176	36098720	9220
92.34	923	4310510	726663	5348947	111121	110226	36491860	4836
93.22	932	5825078	692538	5171532	215062	34775	36841576	3777
94.10	941	6696618	662222	5018507	241092	19954	36953516	3928
94.97	950	7292795	663187	5181761	194529	22828	36762640	4837
95.85	959	6992366	655639	4919015	176892	20862	36820732	3626
96.73	967	6592591	678648	4917640	160888	22074	37076072	3476
97.61	976	7233833	657874	4221972	142951	21468	37369240	4080
98.49	985	5081039	485627	2998122	80262	782778	38083920	4080
99.37	994	2231285	324076	2403863	35207	2121372	38131204	4231
100.25	1002	2128790	418285	3029654	52419	1652189	36765920	4986
101.13	1011	3116600	578816	4766304	47650	647907	36590872	4986
102.00	1020	2903709	546748	3344497	119034	2918812	36800276	21922
102.88	1029	2050456	304929	2378375	109071	10798832	38522028	73785
103.76	1038	2154049	392502	3084152	143857	7823255	37030716	30539
104.64	1046	2687332	439787	3749797	205340	7691677	36832892	67888
105.52	1055	6991136	488287	4849439	86361	4714966	36433576	18444
106.40	1064	7745959	339294	2359232	68483	5134234	37366344	15419
107.28	1073	22769176	273283	1575194	34422	2810116	38964384	9826
108.15	1082	31823770	283490	949512	36355	1912413	36665560	11186
109.03	1090	38359328	310729	888880	45595	1425396	36146392	7102
109.91	1099	52176584	328123	948245	34784	1298685	35924440	8314
110.79	1108	47201432	325464	958818	33394	1790395	36175340	7557

111.67	1117	35708088	286872	1178530	25545	1823199	37625544	6346
112.55	1125	17196396	194408	821773	34363	504412	36617312	4382
113.43	1134	6980883	291460	2100142	222610	192934	36368340	4229
114.31	1143	6087437	547592	3668810	118490	122321	36803748	3626
115.18	1152	6577657	601641	4159319	94273	35833	37010260	3474
116.06	1161	7560582	655214	4619817	96869	26459	37304004	3777
116.94	1169	6408155	686317	4600469	86181	18897	37205188	3926
117.82	1178	6635847	683781	4393645	88474	18444	37177592	3626
118.70	1187	6580649	652560	4549493	74522	18896	37458600	3777
119.58	1196	6716907	691637	4233672	59908	19956	37293968	4534
120.46	1205	5744380	668018	4553160	74162	18293	37386996	3777
121.33	1213	6493075	672367	4404574	136549	301047	37240120	12699
122.21	1222	4756099	510931	2943431	145971	3177854	36989028	20257
123.09	1231	7293132	507674	2736402	156721	5512418	36686212	25550
123.97	1240	4811563	373176	1969264	167773	7266933	36917620	101758
124.85	1248	3518957	305472	1776239	145668	10698521	39490696	130034
125.73	1257	3025420	325706	1717115	133046	8435644	39825744	41579
126.61	1266	2317496	189395	997777	172967	11812758	40771828	285168
127.49	1275	3189180	221706	1400903	219290	12775152	38014244	111435
128.37	1284	2162662	133589	608050	213248	15535149	37613768	88604
129.24	1292	2086004	116741	762836	230101	16049301	37616856	106596
130.12	1301	2477614	150560	1009245	244837	14799530	38405840	83917
131.00	1310	5674176	272558	1557498	163545	11131999	37074336	28575
131.88	1319	5255656	235777	987322	146394	9150082	38141048	41578
132.76	1328	2481377	148628	538171	177133	13634485	39302136	80286
133.64	1336	3653892	116801	688193	393464	16653294	37355152	84974
134.52	1345	2897352	239462	1197740	176470	10712465	36855860	55186
135.39	1354	2850490	294058	1654553	186678	9386700	36525248	38706
136.27	1363	3170278	300521	1180460	197668	11146522	39161632	32204
137.15	1372	2263203	297200	1602738	140475	9788284	37030524	44604
138.03	1380	2959209	484116	2552075	52481	3666083	36694124	48182
138.91	1389	2690348	610646	3893944	39132	574872	35993728	5894
139.79	1398	2454176	668380	4564523	52419	178267	36113968	4532
140.67	1407	2648949	673094	4304117	104359	579863	36239996	9068
141.54	1415	2470822	399323	2487457	186254	7598555	36909704	43241
142.42	1424	2770660	308553	2063405	226416	13014231	40684016	61840
143.30	1433	2404129	303963	1479466	186254	11858740	39870520	113855
144.18	1442	2468096	298226	2020059	259151	11953358	37148256	197317
145.06	1451	2878438	264828	1522354	137514	11180876	36506916	82102
145.94	1459	3545724	347144	2077428	197427	8024168	36517724	87090
146.82	1468	3363037	209747	1016368	323108	14944955	37190520	119750
147.70	1477	2832770	193864	1411047	274915	17112538	37862352	762067
148.57	1486	3928250	286991	1846914	171517	12336512	40244744	353059
149.45	1495	2709105	239703	1157940	277753	10677484	37929520	764485
150.33	1503	1632684	175081	1039866	178403	16184594	47522392	640042
151.21	1512	2208306	294058	1876636	157566	10897166	42408084	128824
152.09	1521	3020571	353065	2538541	149896	7079940	37390468	47626
152.97	1530	2726801	335307	1935380	206184	10331531	37667232	39763
153.85	1538	2751300	220136	1820032	252265	14457920	38086428	58512
154.73	1547	3073959	331324	2299318	168920	10817071	36934024	24342
155.60	1556	5312687	579060	3544457	107077	1429171	36183448	8011
156.48	1565	6198147	615172	3996427	120001	299531	35868280	4988
157.36	1574	7829721	627494	4048151	124711	117029	35931388	4836
158.24	1582	7031810	655515	4237243	86179	53524	35931584	4231
159.12	1591	7577663	687466	4283876	118793	44149	35925212	3474
160.00	1600	6755434	676957	4395237	202318	25096	35915564	4229
160.88	1609	7190312	688914	4483052	98861	35229	35847820	4080
161.76	1618	7211011	667475	4663749	244294	27516	35744564	3476
162.63	1626	6537417	659140	4785556	139509	19502	36010712	4231
163.51	1635	6952777	668082	5420478	145067	19351	35825240	4231
164.39	1644	6605763	640781	5458812	188490	19956	35656172	3625
165.27	1653	6063216	686438	5751159	141683	24642	35710212	3779
166.15	1661	6747883	658356	5579703	179187	19200	35620852	3777
167.03	1670	6430205	678953	4788933	135221	19048	36041592	4231
167.91	1679	6237447	672852	4561024	89983	18142	36252928	3626
168.79	1688	5768239	613484	3991192	94636	46870	36465228	3474
169.66	1697	4689997	458993	3140967	141985	641707	36879984	7708
170.54	1705	4735521	399204	1952593	178465	7714837	41183112	105841

171.42	1714	2450690	235477	1026272	223940	10829037	40877784	70609
172.30	1723	3849940	236684	983824	222552	9993878	36533164	94801
173.18	1732	2969932	71807	781496	562269	25575780	37122392	72879
174.06	1741	3001536	145606	763197	416116	19629452	36911828	139862
174.93	1749	19034914	219954	832050	269898	12167299	38158800	45360
175.81	1758	25335978	265131	1314240	205338	8325682	36920512	54126
176.69	1767	7734475	285180	1577009	314653	11106282	38078512	109619
177.57	1776	4065087	187886	1170985	307708	15650660	37745976	555973
178.45	1784	7429294	307829	1889132	284153	12264812	37744044	250393
179.33	1793	10254186	327578	1577853	214156	8993076	36555164	104178
180.21	1802	5987029	221768	1154496	303419	19494062	37161572	159518
181.09	1811	3335088	232034	1155274	277389	14904811	38413368	75296
181.96	1820	3235416	235354	1276671	215788	12298828	36991924	44149
182.84	1828	3394955	362486	2512510	138663	7292360	37336624	25853
183.72	1837	5515289	556169	3395268	101278	1770594	36589328	7254
184.60	1846	7504033	609376	3285717	52479	403258	36156040	5289
185.48	1855	2381898	142891	520838	12317	82403	35382112	4836
186.36	1864	289402	21678	110339	6701	49894	34794232	4079
187.24	1872	147422	16986	53930	5494	29027	34652572	3625
188.12	1881	69349	5553	40099	5434	23433	34711436	4383
188.99	1890	26911	4466	33335	5675	20862	34760264	4383
189.87	1899	25248	3800	34241	4950	18594	34639640	3174
190.75	1908	21619	3619	33397	5069	19954	34640220	3929
191.63	1916	22678	3558	30435	5615	17688	34644656	4079
192.51	1925	19047	3438	31221	5012	20107	34632692	3928
193.39	1934	19048	3498	30919	5252	17688	34608376	3929
194.27	1943	18745	3558	29710	5133	18293	34608180	3777
195.15	1951	18442	3317	30919	5312	17536	34538700	4383
196.02	1960	18748	3558	30434	5133	16780	34678048	3626
196.90	1969	18293	3317	30678	5494	17537	34644464	3625
197.78	1978	18291	3317	30797	5555	17537	34556844	3777
198.66	1987	18897	3197	30435	5010	17233	34623236	3777
199.54	1995	19956	3438	30135	5374	17537	34630760	3476
200.42	2004	17385	3498	30376	5010	17233	34718000	3777
201.30	2013	18140	3317	30316	4950	17688	34528664	4079
202.18	2022	19502	3438	30134	4830	17991	34449344	3777

Table 4: Left hook carbonate major elements

Left hook carbonate minor											
Ave blank		**51,720**	**27,259**	**28,449**	**41,873**	**128,371**	**520**	**801**	**67**	**607**	**7**
Trace for Mass:	Distance (um)	Mn55(LR)	Ni58(LR)	Zn64(LR)	Rb85(LR)	Sr88(LR)	Mo98(LR	La139(LR	Ce140(LR)	Th232(LR	U238(LR)
Resolution:		Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Time	10	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity
[sec]	um/s	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]
0.90	9	59287	33399	33700	45238	137283.3	800	1000	100	300	0
1.73	17	48951	27479	31894	45337	130624.8	400	801	100	901	0
2.55	26	48850	25474	29887	42628	132446.3	500	500	100	300	0
3.38	34	51058	28885	30790	45739	133049.4	601	400	100	601	0
4.20	42	48047	28182	27479	42728	131837.1	401	1001	0	700	0
5.03	50	54469	25374	28884	46542	128821.5	600	902	200	500	0
5.86	59	51960	26176	27079	39619	127000	200	901	0	400	0
6.68	67	50356	32997	25774	42830	129412.5	701	400	0	300	0
7.51	75	54669	25274	29586	43632	128815.4	700	601	0	800	0
8.34	83	51960	27680	31391	42931	132440.2	1001	400	200	1001	0
9.16	92	52562	25373	31693	41626	127000	801	400	100	601	0
9.99	100	53667	27680	30991	39418	128212.3	600	901	0	501	100
10.81	108	51860	25372	28383	42427	127603.2	0	901	100	601	0
11.64	116	47545	26777	28181	43532	127597.1	500	901	0	500	0
12.47	125	56777	25574	28383	39619	127609.2	400	1302	100	901	0
13.29	133	51660	27080	24470	39117	126396.9	500	1002	200	800	0
14.12	141	50255	27580	26677	39319	122766.1	200	801	0	500	0
14.94	149	48949	28884	26978	39017	127000	600	1201	0	400	0
15.77	158	53768	27580	29286	43833	124581.5	902	701	0	801	0
16.59	166	53967	26677	26477	43130	120956.7	701	1101	200	1001	0
17.42	174	50155	27480	31694	42228	125793.8	400	700	0	300	0
18.25	182	50254	27480	26175	42628	121553.8	401	601	0	200	0
19.07	191	50656	27279	29286	41024	123369.2	900	801	100	501	0
19.90	199	47645	25373	29686	41024	123375.3	801	1302	0	600	0
20.72	207	50054	31191	28082	43732	125190.7	1001	1301	100	400	0
21.55	215	68034	31693	30489	86890	2659341	901	11031	50156	8422	19756
22.38	224	660518	163348	94419	433896	3368145	2104	46040	161116	13036	18853
23.20	232	379264	149858	86689	589644	4572978	1902	62198	161716	18953	16345
24.03	240	549718	154587	66010	491410	3337947	1602	54871	166840	17048	32194
24.85	249	643230	124042	58282	400934	5345955	2605	48347	150363	14941	17047
25.68	257	1131136	332016	67415	472628	8286469	2104	114803	359724	32195	25374
26.51	265	1657752	279584	54871	467876	5666610	2806	74042	161116	19957	21762
27.33	273	979260	184428	50254	468490	4088512	801	39919	151466	11130	10929
28.16	282	775308	171574	48047	313588	5578810	1501	36509	112398	8823	12133
28.98	290	728720	149764	49954	394088	3749218	2204	30390	107279	12835	9826
29.81	298	603262	168150	67114	538150	3410515	2104	28382	92110	14439	12134
30.64	306	1300968	554406	100643	581444	4090296	3208	33599	92114	14941	26279
31.46	315	816864	238028	70226	635092	2809146	1803	34401	103863	13136	16545
32.29	323	500000	172772	56878	495830	4214915	1904	39519	108681	14640	12234
33.11	331	619016	159509	62197	374520	5089531	2002	51661	150461	16144	24270
33.94	339	943188	147247	58684	283400	7878887	1001	79976	134993	12032	25580
34.76	348	920020	146749	79260	415370	7364784	2505	41925	154689	14440	14540
35.59	356	802096	155787	74140	375734	5077999	1402	52964	182227	15442	10027
36.42	364	930680	165940	60892	471814	5869709	2104	68119	162119	16346	13236
37.24	372	1022698	185337	61193	513688	3188165	2505	101688	208102	27481	28885
38.07	381	997676	354014	67415	416248	4993077	7219	188851	851424	102150	75948
38.90	389	735320	398912	61595	438648	6648480	6417	189153	585480	89699	47445
39.72	397	646324	260661	60993	469102	4878240	3106	108986	377924	35305	20559
40.55	405	838932	170254	46241	559656	2914016	3005	70426	203829	21160	20758
41.37	414	1024892	206544	48147	354374	3142074	2204	32296	112695	12333	9625
42.20	422	1554752	261761	53867	387342	3492391	3007	29586	96025	12534	11933
43.02	430	677656	163222	62697	457450	14263786	2805	30790	102151	12836	13337
43.85	438	443665	144835	163288	307758	41828120	2204	35505	75347	9124	7720
44.68	447	341608	103162	73438	159003	57145368	2304	27982	83977	19055	7920
45.50	455	1575432	93817	85482	280296	66017160	4611	70025	264716	24069	38523
46.33	463	1653888	156791	104259	341580	24053660	1302	94131	271408	25474	23667
47.15	472	1091024	132480	65810	292648	11306326	1401	49052	186350	17550	21762
47.98	480	770124	165936	61494	369188	6931137	3608	39518	145749	16446	12535
48.81	488	515600	132580	54268	366880	5226199	2204	34102	98234	11229	9926
49.63	496	682588	154078	49853	393568	4464114	1002	32495	76250	11431	7821
50.46	505	637322	155995	53065	333022	3322218	1503	35807	125861	13236	15042

51.28	513	531724	137102	55875	310703	2474272	2104	31392	89098	14140	86795
52.11	521	663480	247175	77151	477978	4756375	2405	27379	81869	12132	23067
52.94	529	569424	187544	66313	414434	3415992	1903	17048	76453	7018	12835
53.76	538	470620	208854	57982	488468	3152228	1804	35806	128561	13036	13236
54.59	546	450546	128562	54068	379782	4002651	1803	43835	97129	11832	10628
55.41	554	466464	140315	49552	499162	2480340	1402	50555	151169	10728	10828
56.24	562	780156	167053	60390	596484	3215187	3007	55172	98636	11431	13438
57.06	571	1375628	343204	65911	548708	4737744	5714	37110	119429	11231	17149
57.89	579	1444328	531298	65208	479292	5237432	4411	55574	164327	24169	27984
58.72	587	717344	170056	55371	477876	4119592	2806	59989	188548	12835	16044
59.54	595	960484	123743	58083	265596	6510561	2305	72333	224150	19454	13636
60.37	604	1161828	176201	55072	476902	6880960	2304	62898	205138	21962	23669
61.19	612	648316	191164	52362	445196	4161703	2806	69227	165435	218124	279775
62.02	620	664282	215497	86334	438528	4439070	1703	32295	78857	70025	81567
62.85	628	511242	157399	53667	438934	2881936	1202	24370	54469	20057	19255
63.67	637	418258	169855	55372	477354	1548318	1602	16746	72334	15041	13437
64.50	645	427041	167345	55673	386012	1701842	2706	62498	213286	21059	30594
65.32	653	465566	135895	52062	408880	7689913	2406	105966	278899	18853	14641
66.15	662	705332	151968	69629	508884	4577912	2103	52362	346509	15444	17248
66.98	670	643322	143839	50456	348536	5733802	2806	84480	209558	19355	15142
67.80	678	497534	155188	54770	378648	3332519	901	50756	121138	13536	19155
68.63	686	709896	164026	58785	453964	4337578	2305	71330	261710	17048	17248
69.45	695	654704	147548	52262	548338	4854216	1101	36710	137504	14941	16546
70.28	703	466966	187653	57680	680068	3744272	1803	38415	174533	13638	16546
71.11	711	495720	160207	46742	635292	3662986	2004	180206	408808	33398	23568
71.93	719	455074	142224	52964	424108	3541164	2606	61896	181234	13738	22665
72.76	728	561342	124744	62599	365258	7092605	2906	69370	101548	9726	14941
73.58	736	629056	828876	271780	303118	1113765	6215	26075	76550	14039	11130
74.41	744	545420	1828912	144950	357826	2822906	8724	34603	90204	11731	13537
75.24	752	641904	585166	53666	376640	3327561	3609	34203	81368	7821	7721
76.06	761	967416	192590	46442	257637	7162182	1502	15142	67215	4310	4109
76.89	769	364858	92513	151474	96728	14165910	801	12534	43131	1603	1101
77.71	777	322948	45037	45639	83676	14517170	701	18753	59185	2506	2605
78.54	785	633888	94637	51560	147648	11365046	901	44134	169264	14039	9225
79.37	794	826248	86789	43631	159108	13195120	1502	69022	218712	14240	11130
80.19	802	823292	122138	49351	246369	8674771	1001	44636	101146	11531	6416
81.02	810	1095568	215679	51761	293254	4987868	1101	36708	111789	6817	8321
81.84	818	1303304	96827	43332	218082	10183211	1001	43833	108878	5414	6215
82.67	827	1060888	52463	44434	62899	11414647	801	32195	73939	1703	4209
83.50	835	551262	34803	36609	43031	11804797	200	22365	40521	700	701
84.32	843	236811	29888	32195	42929	6020297	200	4912	14941	1002	0
85.15	851	135391	32195	29386	45237	3316174	600	2706	7922	300	0
85.97	860	193173	30891	36207	42328	8795782	300	3407	11530	1001	0
86.80	868	311370	30188	40422	37913	14948526	1101	6315	13738	400	300
87.63	876	338660	28482	48248	39519	17415644	500	9424	17047	1201	300
88.45	885	368174	35806	41123	41124	17282474	300	8723	16547	601	801
89.28	893	571746	41123	43531	39117	20700312	400	10327	13036	1202	700
90.10	901	741832	52262	43932	42427	21918432	500	14941	28884	601	1202
90.93	909	1083316	64205	41124	41525	23965004	100	26678	35505	1201	1001
91.75	918	1262528	84078	39518	40823	26352896	700	26375	46543	901	2204
92.58	926	1305496	969344	40722	44235	24069126	800	22866	31090	400	1403
93.41	934	957588	3727328	48048	40322	14501538	701	9625	16245	1101	100
94.23	942	486786	7111322	60994	37512	6917265	500	4209	10628	400	0
95.06	951	187241	13677234	68319	42529	2153735	601	1803	4210	801	100
95.88	959	74441	9737791	66311	39618	443315	400	1001	500	700	0
96.71	967	60491	9710843	72033	48851	258240	601	1603	600	601	0
97.54	975	81468	10109887	72836	40421	858228.8	700	2905	3308	901	200
98.36	984	127958	8969337	75646	39819	2570459	1001	4511	13137	801	200
99.19	992	285712	7102979	68119	41123	4285083	802	14741	41526	1703	100
100.01	1000	538106	5091860	73437	42529	11334745	901	23768	71130	2204	1904
100.84	1008	843064	2703088	79969	53767	15137858	300	25875	83879	1702	601
101.67	1017	1023436	567242	52965	54670	21314824	600	53667	139011	1903	901
102.49	1025	1327544	231483	53466	47946	18804762	8924	68419	149960	2304	1802
103.32	1033	1554568	277337	50956	69323	18190926	16145	55072	151367	3106	1603
104.1439972	1041	41927	94720	7519	8622	78765	200	4210	801	100	1101
104.9700012	1050	45639	93816	6716	9025	84029	200	3608	500	100	1502
105.7949982	1058	42528	99639	10227	11833	80081	701	3909	1202	100	700
106.6210022	1066	41926	95422	9726	10629	88612	500	2205	500	0	1403
107.4469986	1074	42929	87492	8925	10127	80743	800	3709	900	100	1503
108.2730026	1083	41023	93516	9425	10227	84677	400	3307	1502	400	2003
109.098999	1091	40822	96126	8221	8321	78117	500	3608	1302	501	1702
109.9250031	1099	41524	93313	9123	12534	85987	1302	2304	801	0	1101
110.7509995	1108	43130	98034	7619	9926	81397	600	3507	701	501	801

111.5770035	1116	43131	87088	9224	11532	83361	701	4511	500	300	1603
112.4029999	1124	41927	100042	10829	10429	83368	100	2705	800	300	1503
113.2289963	1132	43832	96426	10227	11130	83361	901	4310	1202	500	1202
114.0550003	1141	40822	95723	9625	10529	82707	902	3507	1402	600	1502
114.8809967	1149	42429	93816	10528	9826	78772	501	3407	1201	0	2104
115.7070007	1157	42528	94318	9525	9425	80743	500	4711	900	0	800
116.5329971	1165	44335	97530	8924	9526	83368	100	2304	1703	200	1703
117.3590012	1174	46341	90503	8423	9426	85987	1602	3810	1402	100	2304
118.1839981	1182	44334	95924	8423	10629	76801	1302	3006	1502	500	1702
119.0100021	1190	45639	91707	8923	9927	82707	701	3508	701	400	1703
119.8359985	1198	40020	88797	11230	10829	85332	700	4712	1202	300	1202
120.6620026	1207	40521	95624	9726	11531	83361	1201	3207	700	600	400
121.487999	1215	39518	91206	8221	10027	84023	601	2805	1302	400	800
122.314003	1223	41325	99440	10227	11732	82707	801	3709	1602	300	1703
123.1399994	1231	41525	90905	9926	10628	84023	400	3808	1001	200	800
123.9660034	1240	40924	93114	10127	9926	84023	902	2906	1202	400	1101

Table 5: Left hook carbonate raw data minor elements

Left Hook Carbonate down 30

		left hook carbonate major down 30 um						
Ave blank		**18,486**	**3,473**	**28,996**	**4,998**	**17,321**	**32,838,573**	**3,343**
Trace for Mass:	Distance (um)	Mg24(LR)	Ca43(LR)	Sr88(LR)	Ba138(LR)	Al27(LR)	Na23(LR)	Ti47(LR)
Resolution:		Low	Low	Low	Low	Low	Low	Low
Time	10	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity
[sec]	um/s	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]
0.953999996	10	18506	3544	30930	5381	20727	32101650	4291
1.832999945	18	18060	3544	30870	5262	17174	33496092	2513
2.711999893	27	18506	3721	30397	5262	17469	33379668	2958
3.589999914	36	18949	3721	29982	5025	17617	33246044	3699
4.468999863	45	19541	3663	30219	5026	17322	33174224	3403
5.34800005	53	17322	3426	29330	4788	16433	33153056	2810
6.225999832	62	17914	3721	29627	4967	18506	33037388	3848
7.105000019	71	18653	3662	30041	4908	17914	33025672	3401
7.984000206	80	18357	3071	29271	4848	17323	32958954	3107
8.862999916	89	18506	3603	28741	4967	16877	32889968	2958
9.741000175	97	18803	3485	28208	4908	17765	32828732	3846
10.61999989	106	18504	3426	29035	5085	16877	32764472	3254
11.4989996	115	18358	3545	27913	5202	17026	32687360	2958
12.37699986	124	17322	3426	28267	5026	16582	32715144	2959
13.25599957	133	19247	3248	28799	4788	17172	32584544	3699
14.13500023	141	18653	3485	28384	5322	17322	32544100	2811
15.01299953	150	18506	3308	28740	5025	16728	32473224	3553
15.8920002	159	18653	3308	28385	5085	18357	32495716	3846
16.77099991	168	18358	3485	28858	4433	16582	32363036	2810
17.64900017	176	17766	3308	28148	4907	16729	32368518	2810
18.52799988	185	16729	3367	27321	4554	17172	32323348	3403
19.40699959	194	18357	3189	28031	4433	17320	32278364	3551
20.2859993	203	17469	3367	27262	4849	17174	32164776	2958
21.16399956	212	17617	3248	27913	4670	16580	32133968	3402
22.04299927	220	1072611	240708	2004747	62453	32573	32195394	4291
22.92200089	229	6525839	507205	2874029	88061	205667	33114690	3403
23.79999924	238	6948160	474201	2954224	83507	2972935	41441084	3107
24.67900085	247	6909651	531630	3350734	102017	465675	34548256	3699
25.55800056	256	4879319	478699	3713236	71324	92393	33080480	3550
26.43600082	264	5357749	687644	3766770	92675	44418	32943456	3254
27.31500053	273	6355007	640867	3718268	131885	36275	33082182	2958
28.19400024	282	6694191	566705	3013841	112310	306502	32799628	6512
29.0720005	291	6111433	592367	2550224	145487	1446925	33003936	8142
29.95100021	300	4462054	449894	2740299	275841	2388641	32929280	25317
30.82999992	308	4453643	382828	2176784	139041	2495851	33693408	12137

31.70899963	317	4458085	404711	1998120	83446	1865383	33559216	21172
32.5870018	326	2104810	213740	1128555	67479	2772453	37224684	95650
33.4659996	335	2498828	325459	1747990	115799	1921362	34364168	15398
34.34500122	343	4207684	374072	2246643	85815	2648516	33416524	11694
35.22299957	352	3844166	385077	2042783	127215	3036911	33952336	29463
36.10200119	361	13283629	384072	1825545	98884	2109394	32601932	11991
36.98099899	370	18867586	571372	2052292	59376	543709	32506110	7697
37.85900116	379	16238974	476035	2672354	133307	665422	32716088	7697
38.73799896	387	5886500	446876	2250541	86228	2402875	32653340	58039
39.61700058	396	5773360	439543	2342277	98825	2676630	32537106	22058
40.49499893	405	9447874	408786	2022843	100127	3586370	32650128	15396
41.37400055	414	5727622	475683	2551051	121300	3202133	32864454	113518
42.25299835	423	3928861	411509	2276989	75464	1327595	32498550	6069
43.13199997	431	3538104	388092	1694604	49559	590206	32227902	5475
44.00999832	440	2011669	357635	1423081	102592	743898	32121116	5920
44.88899994	449	1605520	335159	1621213	95100	1320779	32171768	7105
45.76800156	458	1324630	215218	1064082	33234	1574866	32172904	7844
46.64599991	466	764629	116332	463437	26019	911659	32381936	10953
47.52500153	475	516168	46247	345214	42166	1140875	32254552	6808
48.40399933	484	717695	113729	891690	28266	741973	32079726	6364
49.2820015	493	1625949	164059	1050066	96281	2123451	32787908	19395
50.1609993	502	2703303	148564	1231636	117159	7276146	33254740	36422
51.04000092	510	3528347	231779	1206505	148860	6427229	32779404	44269
51.91799927	519	2892114	299259	1023045	174822	9878416	32942512	32130
52.79700089	528	3114626	254074	1637354	119643	8095106	32639356	28130
53.67599869	537	4574462	408200	2690368	72566	2951767	32536350	10215
54.55500031	546	3176240	284947	1581109	47844	5857890	41404984	7548
55.43299866	554	1491659	79191	506018	64639	13430293	57614760	8732
56.31200027	563	985546	98589	756015	95040	13403738	58549552	17469
57.19100189	572	2087487	197121	1286582	136263	7617881	47341856	18653
58.06900024	581	2705074	180207	718227	148208	5354323	36436744	31092
58.94800186	589	1729882	324278	2616268	149865	4566595	34249068	30202
59.82699966	598	2310631	524945	3760486	107578	942017	32755780	6807
60.70500183	607	4894273	503183	3460236	87173	485519	32399136	10805
61.58399963	616	4216283	483193	3155757	134843	2037290	32675264	20282
62.46300125	625	2981522	422453	2700267	135551	4151267	33001856	58780
63.3409996	633	2868997	420144	3395066	1000062	5249641	40401964	19395
64.22000122	642	3077924	556469	4998129	140107	1656307	35450540	12286
65.09899902	651	3975355	561082	5146895	211552	1382080	33282712	29759
65.97799683	660	3903228	599411	3643046	140343	900556	33233948	6661
66.85600281	669	3908308	469768	2334587	113255	659947	32530302	7845
67.73500061	677	2424776	391642	1349685	65173	4852221	41037192	10856
68.61399841	686	1497122	168731	888247	64580	10515960	57409884	4142
69.49199677	695	2887034	396250	1897879	114911	7783209	50260392	15099
70.3710022	704	4434554	425885	2455051	89776	3068309	37677528	11548
71.25	713	6357535	437060	2772358	118462	1869966	34475112	6808
72.12799835	721	1820956	199014	1292908	196590	4795048	40233752	6956
73.00700378	730	938317	95749	971826	154360	11571052	48035104	33756
73.88600159	739	1091865	167667	1441598	95692	10631392	47485304	59225
74.76499939	748	2917711	381290	2791294	82147	4422388	37660140	35386
75.64299774	756	5399943	539022	3295038	96814	1100004	32776192	10807
76.52200317	765	5768327	564750	3351868	141288	720802	32398758	9917
77.40100098	774	5179049	566288	3278016	133363	508617	31992786	4883
78.27899933	783	5976653	538313	3081362	111659	1052771	32093144	4143
79.15799713	792	5608457	548661	3084090	93267	1027156	32238108	4289
80.03700256	800	6418393	496854	3107644	97109	133114	31982580	4291
80.91500092	809	5199745	403170	2145445	124671	61742	31953664	3105
81.79399872	818	3303590	360649	1681427	50032	276446	31809078	5327
82.67299652	827	1443824	207708	1467384	271463	829329	32551470	58484
83.5510025	836	3094804	310852	2197137	179791	723025	32453946	8882
84.43000031	844	4574745	460599	3248473	136501	955339	32932872	5031
85.30899811	853	6619229	549376	3653394	158264	337006	32431456	4289
86.18800354	862	6713564	558536	3487641	110122	57893	31955364	3994
87.06600189	871	5799867	561971	3904693	189728	35091	32105240	2808
87.94499969	879	6336296	612242	3262518	121772	22800	32075380	3551
88.8239975	888	7124497	595681	3523645	139633	19985	31938164	3699
89.70200348	897	6814253	565045	3426594	167429	18506	32013198	3402
90.58100128	906	6579114	560019	3279953	116863	16433	32010552	3697

91.45999908	915	4679593	342137	1588964	42048	18950	32026996	3700
92.33799744	923	2892976	273297	1806911	48967	24281	31718358	3253
93.21700287	932	4964463	427536	2918420	71147	71219	32028128	3403
94.09600067	941	5805962	479230	2679583	73335	188492	31925692	3402
94.97399902	950	6207374	502471	3147653	67656	71219	32370976	4143
95.85299683	959	6268020	524239	3296940	76053	23688	32354344	3402
96.73200226	967	7695891	567470	3807382	85339	27982	32562620	3403
97.61100006	976	6355291	628564	3746524	78302	17617	32357744	3846
98.48899841	985	6268776	600116	3529552	84039	25169	32199552	3996
99.36799622	994	5884751	565754	3056248	130468	363809	32465476	3403
100.2470016	1002	5621049	523170	2820506	90308	1390231	34930412	3402
101.125	1011	5962950	487272	2754841	86465	1046847	34143228	4440
102.0039978	1020	5342369	442266	2234996	107224	1026559	32539184	8732
102.8830032	1029	2902910	232903	1208041	44825	1094529	32894504	5326
103.7610016	1038	1905652	196706	1222062	25014	181828	31915864	6364
104.6399994	1046	944681	207885	2332697	46956	864569	32036256	6513
105.5189972	1055	1158647	405536	2548984	67714	997247	31744628	5178
106.3970032	1064	1090093	264720	2000530	71263	1557986	34345268	8585
107.276001	1073	1210315	181979	948993	29212	1029235	33867664	5178
108.1549988	1082	1350547	173286	1184268	58312	303395	32312764	4143
109.0339966	1090	3731652	359053	2534006	101722	400968	32488912	4883
109.9120026	1099	6076185	467754	2883904	97465	1133911	32607414	13028
110.7910004	1108	5055396	433749	2935359	96223	1800520	32065552	11399
111.6699982	1117	5440200	461367	2703338	52752	1100748	32300478	5032
112.5479965	1125	4235514	286663	1324140	64108	538231	32154948	7697
113.427002	1134	1364155	190084	1087034	82915	946164	32273452	7104
114.3059998	1143	1782902	233731	1300722	49618	641729	32154004	7253
115.1839981	1152	2881565	277318	1750365	72625	515876	32035312	4439
116.0630035	1161	5767004	454270	2693404	113610	694445	32379292	4142
116.9420013	1169	5262067	467639	2836524	84276	378616	32021136	4734
117.8199997	1178	5203761	492534	2829377	120650	1031450	32150034	10955
118.6989975	1187	5173261	470061	3115854	132241	1214172	32055344	5475
119.5780029	1196	6404100	487803	2918266	205991	749674	32169124	5029
120.4570007	1205	6292377	510043	3049562	133719	703919	32180652	12731
121.3349991	1213	5501365	512586	3044885	103439	1232386	32072544	9621
122.2139969	1222	8454159	485382	2810808	90428	1137467	32637844	9623
123.0930023	1231	8617172	479700	2981487	249225	1483951	32325992	6364
123.9710007	1240	11713464	476688	2746028	105272	541045	31787720	5031
124.8499985	1248	9850774	555288	3136077	102375	618931	32471712	3699
125.7289963	1257	6780375	519266	2960425	110299	466715	32191424	6067
126.6070023	1266	4411449	423459	2215234	72329	213811	31812480	4735
127.4860001	1275	2572255	244671	1309061	36666	1699825	36502704	3550
128.3650055	1284	2115158	226398	1242167	47727	887671	34207112	2810
129.2429962	1292	2090293	199367	1103890	30574	483297	32791688	4142
130.121994	1301	624261	72033	555226	40806	1240519	31577552	5474
131.0010071	1310	1126960	97050	493659	24481	1164417	31421440	7993
131.8800049	1319	924104	97997	700954	50209	513357	31567724	14955
132.7579956	1328	1158942	157080	1004588	155308	814673	33244722	4734
133.6369934	1336	1460551	238344	2038093	143596	219586	31855950	4883
134.5160065	1345	4388486	406665	3172046	142769	265487	32342248	4291
135.3939972	1354	4567374	471543	2371312	99061	1176856	31928716	7844
136.272995	1363	2810666	239645	1104303	37611	1150945	31614030	7697
137.1519928	1372	770698	93976	537011	17385	421848	31425976	4586
138.0299988	1380	314942	74340	593495	20994	209072	30922856	3402
138.9089966	1389	534530	178313	2187203	57189	877013	31647104	6215
139.7879944	1398	1777557	382828	2998107	70789	1009833	33171200	5327
140.6660004	1407	1640461	214863	1119801	26966	222697	31376456	3848
141.5449982	1415	633292	75640	528674	21289	171611	31298400	3846
142.423996	1424	525054	74045	473256	48849	1680435	32391008	14656
143.3029938	1433	784766	87114	596983	37493	2774378	32863508	26352
144.1809998	1442	1685768	193809	1540013	39919	790540	32530680	7253
145.0599976	1451	3001084	310378	2392421	45775	200929	31561866	3699
145.9389954	1459	3486011	349117	1986414	47785	175017	31685850	3996
146.8170013	1468	1607888	128455	817759	35186	148513	31497416	3550
147.6959991	1477	795132	117812	698647	75878	269338	31050054	5031
148.5749969	1486	757964	81199	897957	88533	2047354	31381938	17766
149.4530029	1495	1444120	186416	1189359	86109	4156465	33981256	16580
150.3320007	1503	4838306	262177	1299416	70791	4772888	34414820	19691

151.2109985	1512	14735574	273592	1289831	53700	4543229	40550896	7251
152.0890045	1521	22485992	374549	2371253	81260	1523925	35318996	6513
152.9680023	1530	20932316	412933	2561931	70791	246979	31618756	6363
153.8470001	1538	22708634	408966	1644501	52870	86618	31216564	3846
154.7259979	1547	16274790	291453	1084258	41574	143921	31109022	6364
155.6040039	1556	6227314	180680	1097446	38618	431178	31307472	5772
156.4830017	1565	1007016	173285	1674446	29037	383649	31201064	5178
157.3619995	1574	742268	165539	1122524	27144	579394	31234896	6216
158.2400055	1582	726130	103142	639626	22411	3375540	37403668	11251
159.1190033	1591	186568	21643	149629	10289	10978207	48899216	4882
159.9980011	1600	43529	7389	90605	8455	13082013	56888244	3699
160.8760071	1609	759594	103613	921437	100956	11946690	56725704	3107
161.7550049	1618	3132699	330369	2556615	541978	4830911	44362648	3848
162.6340027	1626	5789188	560964	3709539	141998	986137	33911136	4289
163.5119934	1635	5331832	469352	2607232	87175	285922	32411610	5624
164.3910065	1644	3034395	228170	1180482	37493	105719	31691708	3254
165.2700043	1653	1138211	123665	976439	26966	139628	31327696	7253
166.1490021	1661	1484991	170150	819711	30515	44419	31425596	4289
167.0269928	1670	687928	53582	230181	14309	32721	31583790	3699
167.9060059	1679	148808	9874	57722	6680	66333	31719304	3551
168.7850037	1688	33017	4610	33177	4967	18504	30875228	3697
169.6629944	1697	25319	3839	30159	4552	17323	33153624	3550
170.5420074	1705	19542	3544	26848	4139	16433	30721004	3256
171.4210052	1714	102314	3662	25485	4078	15398	30685852	3402
172.298996	1723	18655	3130	25900	4433	16582	31920588	3550
173.1779938	1732	16877	3367	25428	4551	16137	30667140	3699
174.0570068	1741	17320	3189	25604	4433	16137	30683584	3105
174.9349976	1749	17618	3189	25725	4433	16728	30707396	3700
175.8139954	1758	18061	3189	25249	4195	15990	30717414	3551
176.6929932	1767	18506	3544	25959	4255	17322	30673756	3699
177.5720062	1776	17322	3426	25428	4374	15545	30676212	3107
178.4499969	1784	17468	3189	25252	4316	15842	30707964	3553
179.3289948	1793	17765	3426	26079	4254	15545	30634632	3994
180.2079926	1802	18210	3308	24245	4315	16729	30642570	3108
181.0859985	1811	17322	3248	25547	4018	15841	30638980	3105
181.9649963	1820	16876	3248	25664	4315	15990	30607984	3551
182.8439941	1828	17617	3012	25545	4255	16877	30599668	3550
183.7220001	1837	17320	3367	24304	4552	16137	30572452	3107
184.6009979	1846	17025	3248	25428	4255	15990	30662982	3551
185.4799957	1855	17174	3367	24895	4075	16137	30625938	3550
186.3580017	1864	17322	3189	25251	4492	16580	30585304	3253
187.2369995	1872	16433	3189	25902	4611	15841	30620836	3550
188.1159973	1881	16729	3367	25310	4195	14952	30573584	3403
188.9949951	1890	17915	3130	25367	4195	15841	30561868	3699
189.8730011	1899	17172	3248	25369	4196	15841	30597966	3402
190.7519989	1908	17468	3426	25131	4492	16434	30603258	3402
191.6309967	1916	17617	3071	25426	4255	16433	30634254	3402
192.5090027	1925	18061	3130	25190	4255	16729	30676590	4142
193.3880005	1934	17320	3426	25902	4077	16433	30529360	3254
194.2669983	1943	17617	3189	24542	4196	15545	30475304	2810
195.1450043	1951	17174	3012	24659	4315	14803	30536730	3699
196.0240021	1960	16580	3248	25133	4255	15988	30525390	3697
196.9029999	1969	17174	3367	25013	4313	16879	30472660	3551
197.7810059	1978	17320	3308	25487	4551	15396	30502900	3403
198.6600037	1987	16877	3308	25013	4075	16433	30544100	3256
199.5390015	1995	17469	3426	25959	4077	16285	30466422	4291
200.4179993	2004	17174	3485	24659	4433	15101	30508758	3254
201.2960052	2013	17322	3248	24836	4315	15990	30484188	2958
202.1750031	2022	17912	3367	25074	4136	16136	30524634	3402

Table 6: Left hook carbonate down 30 raw data major elements

left hook carbonate minor left side

Ave blank		**49,425**	**27,908**	**30,309**	**42,167**	**136,175**	**767**	**914**	**53**	**727**	**-**
Trace for Mass:	Distance (um)	Mn55(LR)	Ni58(LR)	Zn64(LR)	Rb85(LR)	Sr88(LR)	Mo98(LR	La139(LR	Ce140(LR)	Th232(LR	U238(LR)
Resolution:		Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Time	10	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity
[sec]	um/s	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]
0.90	9	52061	34302	32595	46240	148058	600	1402	0	500	0
1.73	17	53164	28283	29887	43632	142140	300	701	200	601	0
2.55	26	53265	28283	28784	42528	139766	200	801	100	600	0
3.38	34	51058	30489	30290	46341	140947	1001	1102	0	600	0
4.20	42	51660	32797	30991	45137	145689	700	1301	0	902	0
5.03	50	47645	24971	27379	41825	141543	1202	1201	0	400	0
5.86	59	49452	27380	30389	42127	137988	701	200	100	300	0
6.68	67	46943	26377	29988	41525	136806	200	601	0	801	0
7.51	75	52160	29085	29687	40622	140368	701	1001	0	1101	0
8.34	83	52864	27179	31593	42428	139766	1201	1002	100	1101	0
9.16	92	48849	26276	26979	39418	140953	801	800	100	700	0
9.99	100	46841	30289	32496	41424	134432	400	1101	100	1001	0
10.81	108	50956	27881	33599	41826	129701	500	901	200	900	0
11.64	116	49852	27781	29386	38817	133257	1001	901	0	400	0
12.47	125	48347	28885	29587	44535	130292	901	1201	100	700	0
13.29	133	48950	26477	29487	43632	133257	500	1602	0	500	0
14.12	141	43933	25072	32395	42730	127327	800	200	100	700	0
14.94	149	51860	27680	30388	40121	130292	900	600	0	800	0
15.77	158	49353	27080	27781	42228	128514	500	1201	0	500	0
16.59	166	50355	28583	28784	38414	130883	700	600	100	400	0
17.42	174	50957	27379	32497	38415	132064	400	901	100	600	100
18.25	182	51459	28584	31593	42027	132660	500	400	0	1001	0
19.07	191	45237	30490	29987	42930	127333	800	501	0	500	0
19.90	199	45538	27479	28885	41224	123777	600	500	0	500	0
20.72	207	50957	26677	31193	38416	128514	1101	900	200	700	0
21.55	215	69047	37414	37612	102451	4943756	1102	19153	69728	10027	11532
22.38	224	599270	171469	69923	410220	5814349	2305	26979	118522	12133	12032
23.20	232	861588	210062	65911	561732	4562341	2706	59103	137200	14339	8221
24.03	240	1296792	322454	73941	434392	5419938	1602	45740	176592	15743	10728
24.85	249	1604920	388638	73741	306043	5559333	2104	34100	130574	13136	10327
25.68	257	1496488	335540	58684	273328	5265167	3307	29386	114604	11331	9125
26.51	265	1914784	628644	72133	256030	5364231	2606	34603	165451	13337	10829
27.33	273	2896512	408916	66413	361356	4391865	4109	60390	206458	14942	16445
28.16	282	1518488	650770	84178	472972	8780512	3607	186153	426456	22866	15443
28.98	290	779612	363142	69925	449240	5369236	1703	88295	312831	12735	8321
29.81	298	633670	200312	70227	479380	5166762	1702	37312	96225	9926	16349
30.64	306	1220148	616400	132700	317914	7147856	6517	24871	111202	17149	9726
31.46	315	1025208	514300	103263	379966	4157225	5112	24771	81972	11030	21165
32.29	323	524812	202021	66612	408084	4429461	1602	30188	73238	8221	24074
33.11	331	538920	121431	117487	382724	3431661	1703	22565	86389	11631	15344
33.94	339	306648	151573	51760	304532	3323872	1603	23667	77855	8522	9426
34.76	348	388456	146045	53433	458698	2584693	3508	14240	53066	21361	57882
35.59	356	258550	129566	94527	714476	920395	3207	10226	46845	14840	39318
36.42	364	622676	150564	63100	466262	3184083	2404	33901	97832	10930	17047
37.24	372	1534416	267595	52361	364760	3115777	1402	20056	102666	9726	14339
38.07	381	1243460	224844	58183	532630	3416376	3207	44936	127057	20860	23870
38.90	389	812276	185638	53767	511254	3787431	2906	45839	220979	26878	21160
39.72	397	664336	175885	60391	392190	4556389	1603	57179	151267	13638	16446
40.55	405	1014236	304028	85987	317922	4422564	2405	22264	97933	8824	10729
41.37	414	1331488	252211	64306	349559	3611310	2305	21662	68720	9424	11633
42.20	422	814852	207777	52562	295268	3120118	1904	29486	96527	13136	10128
43.02	430	528240	156792	61795	435516	2869587	2906	30088	114704	11532	9225
43.85	438	492036	145244	70828	326286	924411	901	73475	98141	14039	12133
44.68	447	206748	87492	54471	245767	1474767	700	57681	177232	17551	18152
45.50	455	471408	131476	67215	436910	2348975	2606	47044	151066	14742	25376
46.33	463	744832	208051	61093	370498	2923416	1903	30289	103858	10026	11832
47.15	472	830932	153074	53467	196993	2632085	900	22063	120534	6717	6618
47.98	480	696780	159205	50254	282185	3141440	1602	36609	102955	11731	10829
48.81	488	643268	155487	62701	377052	5720203	2906	33398	104961	20358	25975
49.63	496	1455766	575348	73739	307654	3978823	6416	39419	118922	15242	16948
50.46	505	1316384	333430	57681	276867	2068239	5213	24070	65106	7118	6717

51.28	513	787956	138913	52061	375330	2452027	2004	34001	92812	9626	11231
52.11	521	756876	321748	70828	443168	3407203	2905	45640	140416	12535	11331
52.94	529	828276	385516	65409	393470	2290592	1703	29888	108980	13336	18351
53.76	538	715184	394368	68218	533644	2677817	3206	50857	137403	16948	30991
54.59	546	656672	373824	61393	417954	3699610	2905	67452	97832	13235	12534
55.41	554	459368	195593	68821	398196	5119124	1903	40924	155597	17650	10629
56.24	562	576732	147450	59086	374620	3320896	1703	38918	161018	16847	12333
57.06	571	669156	174579	67317	343492	2792593	800	53366	95924	10829	10429
57.89	579	1371952	127265	45137	243151	3422767	1001	27380	96226	9325	6918
58.72	587	1289176	120228	46542	243152	2693085	1001	25173	58785	8723	5313
59.54	595	690612	160717	109127	326499	3694740	2707	34402	112897	8422	10829
60.37	604	966056	193375	72233	457720	3431111	3307	40522	117018	12233	18954
61.19	612	810856	222537	75625	611060	3527338	2906	24570	173611	16346	18051
62.02	620	1623528	241048	69121	378952	7231911	2204	76158	160623	11130	22464
62.85	628	1662392	185637	57278	468512	5697246	2605	44134	140419	10127	10829
63.67	637	714488	200212	56978	449138	4784416	1302	79714	129968	13738	17950
64.50	645	733616	215098	55173	433304	4557701	2103	40522	124345	12233	19455
65.32	653	948052	280978	57681	355384	4461626	4410	72233	315614	31192	56705
66.15	662	1667912	415804	58786	321856	7339774	4411	51659	161717	26878	26979
66.98	670	1483016	326736	52864	384502	4845981	2606	43030	181375	17348	16848
67.80	678	898028	161122	43631	405684	3916742	1301	27680	81368	6617	13036
68.63	686	664012	127988	55172	321866	4629248	1102	24270	67315	6316	5413
69.45	695	784752	110286	45539	333130	5542520	2104	24471	69625	8021	9726
70.28	703	489788	162519	76865	440378	5891969	1001	27580	91610	9625	9325
71.11	711	724016	179537	54570	368198	8902116	1301	182021	345112	7520	5212
71.93	719	612842	195310	52161	209763	18486846	1602	42026	110486	4711	11632
72.76	728	320032	92914	47245	171060	18481932	1602	17649	43230	8723	10328
73.58	736	374732	107273	72937	293462	11956943	1302	24170	91209	15944	13939
74.41	744	364440	146044	50054	492986	5506988	1502	21662	74545	11230	11732
75.24	752	399270	145740	51861	668140	1927853	1602	18452	50656	11932	13838
76.06	761	835096	176488	51359	437516	1400738	1803	20258	40122	7219	4912
76.89	769	4358128	409588	47445	210368	2381968	1302	13638	95000	3307	2103
77.71	777	4936832	436410	50055	89699	4434389	1804	21160	55473	2606	800
78.54	785	2515472	225349	46341	83576	11311319	701	14139	40822	600	901
79.37	794	656322	73840	43331	57681	11495500	400	22665	58784	2404	2204
80.19	802	1062384	110587	49251	127663	11647125	2305	35405	94720	3608	2404
81.02	810	1357776	151066	46542	148756	12228111	500	30389	89601	4911	2105
81.84	818	1451760	113497	50957	229875	18957030	1402	30289	91608	11932	6716
82.67	827	748012	91305	165880	299798	9914656	1001	31292	94624	6216	3207
83.50	835	941860	83677	40723	157898	6967485	700	41625	80063	2906	3308
84.32	843	1017160	76247	42428	118519	8589176	600	50054	92510	4310	1903
85.15	851	1011976	81167	56379	105463	10703590	1301	49651	113999	7218	7219
85.97	860	966636	76348	46943	116014	10961338	3909	44536	84781	3709	4510
86.80	868	1179944	80464	40923	133183	12325871	800	55779	88595	2003	2806
87.63	876	1157972	75244	41927	99842	13939837	901	27179	60993	800	1101
88.45	885	637316	49252	40019	62902	15910304	901	12434	31392	901	300
89.28	893	370298	34302	39116	43031	15780555	1402	3909	7921	1101	200
90.10	901	278262	36007	43431	38415	15865322	8323	3106	6616	701	0
90.93	909	278163	31292	39016	40020	15068025	1001	2404	5615	1302	100
91.75	918	278764	35805	45137	40723	17917484	800	3106	4010	500	0
92.58	926	265582	68647	42528	41424	15736802	600	1502	3909	600	0
93.41	934	314726	33701	38717	42829	16275735	500	2204	4411	600	100
94.23	942	263374	30890	39718	43230	17519450	300	2405	28394	200	0
95.06	951	263368	37311	47344	36608	14584846	900	1402	7119	701	100
95.88	959	400843	114245	38315	42127	9674816	3609	2405	16849	1603	0
96.71	967	292693	31191	41424	42427	4083747	1002	3307	18152	1202	500
97.54	975	194780	131190	33499	39518	4522038	1602	8522	49051	1603	400
98.36	984	805392	114000	62001	38716	19353316	2907	20057	82974	701	100
99.19	992	2056576	834992	281772	38917	13402585	4812	21661	42027	801	1301
100.01	1000	2805424	1065824	52663	50757	32289704	5814	20759	84079	1703	900
100.84	1008	1897640	646572	63908	52964	34375696	7018	34000	115406	1603	2004
101.67	1017	1888832	538474	68123	68419	25399804	36911	33900	86587	5313	1202
102.49	1025	3180448	2233456	78657	110184	13318074	103657	279199	295270	20057	7218
103.32	1033	4541280	2717792	93815	242853	7147254	143733	184034	408176	10128	5113
104.14	1041	3554336	2881680	177720	177491	4121665	83578	28283	86292	6517	5213
104.97	1050	2283760	1903600	85282	230592	4143440	52562	37211	111997	7920	10328
105.80	1058	1104540	483812	67013	199404	7142830	12934	45237	105162	8221	9326
106.62	1066	943260	162217	79698	198098	11300074	7118	35606	103456	6516	4711
107.45	1074	995392	231182	66512	208761	15434780	15041	33600	91310	3407	4611
108.27	1083	1412600	1367832	131574	201719	11328463	75646	87893	323868	66010	27481
109.10	1091	1862632	2166392	139913	205940	6330150	144936	268702	956216	193474	63903
109.93	1099	1698776	2747280	136903	196893	7218401	105770	276344	928960	149657	62900
110.75	1108	1505828	1750768	104258	277555	7477103	51058	102451	315402	43530	16446

111.58	1116	1565760	2881936	126856	261293	3583480	130068	30288	104561	13337	5814
112.40	1124	1539648	3733408	95021	87291	1574848	103154	13538	36415	2705	17754
113.23	1132	498500	1005536	77592	47947	1231353	25875	5112	14942	1201	1603
114.06	1141	129568	305127	39217	43633	1182189	5914	2405	8121	801	100
114.88	1149	93130	101766	35204	39217	950009	3509	1302	23471	901	700
115.71	1157	100151	47344	85552	54773	2165952	1102	1001	2405	701	100
116.53	1165	195384	29386	41826	41928	9693243	1001	1001	3107	901	1804
117.36	1174	227761	54491	40822	53869	13248711	802	1001	4511	1202	100
118.18	1182	385618	33097	39720	38615	12726268	901	701	1503	300	100
119.01	1190	262365	35305	43130	49956	14156006	1101	300	7922	400	100
119.84	1198	325384	26076	41224	51663	14802764	900	3006	6016	500	1303
120.66	1207	481108	31493	44134	48248	13210060	1101	18252	43631	1903	3408
121.49	1215	1096668	51258	77354	122540	8988982	1302	43933	96328	3708	7720
122.31	1223	1247880	156193	70728	269328	6070255	1903	89038	137002	8623	11833
123.14	1231	819188	136497	82474	368984	3466591	1002	64205	169865	12333	13737
123.97	1240	498946	130872	85484	332920	2302186	1001	23367	124032	8824	8021
124.79	1248	377402	173704	80062	268098	3324065	901	35206	240865	11332	9726
125.62	1256	518172	88996	95625	270816	3285966	1603	29988	111489	10227	7920
126.44	1264	766800	93414	79460	274034	6372277	1502	21360	72634	7420	5614
127.27	1273	1053340	205847	82372	199405	5774116	1102	23868	108476	8221	13739
128.10	1281	932284	959008	94017	294160	3902078	3607	29084	224549	10328	20059
128.92	1289	865516	755628	137361	486458	1041075	1202	39720	103856	9023	13738
129.75	1297	839976	247995	58283	312882	5367367	1001	43733	154183	10828	8722
130.57	1306	976564	266290	59488	380376	6339509	2304	55172	105061	11131	11432
131.40	1314	834060	197702	52763	314494	8093832	1201	48649	156196	15844	16547
132.23	1322	589732	189253	50656	356492	4491223	1202	79511	147547	15142	24671
133.05	1331	469420	136295	53467	436716	3191159	2104	40422	115006	13537	14942
133.88	1339	492722	133784	46843	401658	2203268	800	43232	103458	13036	29592
134.70	1347	424730	118217	46843	378070	3252194	2204	51058	147849	12735	14943
135.53	1355	480634	117513	57982	285200	5087644	2103	34302	113298	12936	13437
136.35	1364	640336	160122	62397	308756	5901431	1403	41926	146447	18151	18251
137.18	1372	700788	137904	59387	354780	7185287	1202	74642	221827	22865	22965
138.01	1380	634386	167545	52061	311172	5554403	1803	46643	129566	12935	9826
138.83	1388	517534	75445	61798	168155	8204821	1201	13838	115344	4711	4411
139.66	1397	155184	58286	46742	77959	12691822	501	5714	16948	1702	2204
140.49	1405	104358	32896	39618	43331	15838106	300	7720	22966	2004	1503
141.31	1413	220924	28584	46240	79073	15768270	901	16848	55673	1804	2605
142.14	1421	546082	64806	52161	174078	11012227	500	30088	132179	9125	9926
142.96	1430	743246	124645	53365	349242	5188948	1803	30289	77653	8221	29592
143.79	1438	391556	161926	55272	359810	3338643	1603	44233	159919	11130	13437
144.62	1446	605692	132580	52764	406062	6474195	1401	44134	128762	10228	12835
145.44	1454	805504	150662	60692	325374	4543348	1402	33198	108375	10828	12033
146.27	1463	2706032	297098	55372	185034	2860114	2004	24369	85183	5013	19957
147.09	1471	4263376	451538	50254	178501	1290511	1402	31292	118461	7019	19956
147.92	1479	2299624	310066	174755	318544	1086394	2405	53468	163736	81569	95726
148.74	1487	961080	139309	51458	328394	6597967	1603	52764	150268	23468	22164
149.57	1496	633392	117313	48749	427748	4851323	2504	26881	62899	12133	22668
150.40	1504	1005488	184127	57279	603164	3365299	2504	23769	69925	13236	15343
151.22	1512	1596824	203628	52161	359110	4225385	1903	54972	201955	10729	10830
152.05	1520	906992	134086	48649	398626	5845156	1803	41425	101146	9324	16948
152.87	1529	470734	109581	46140	436926	3086937	1502	12133	55272	6717	10729
153.70	1537	229370	85685	52362	296981	2318770	1403	43833	123160	7118	7419
154.53	1545	638206	156395	44536	372626	2887353	1503	32295	128271	12835	16546
155.35	1554	498642	130471	45840	427008	4595464	3106	41725	121932	13236	18050
156.18	1562	864716	97531	43733	179504	8139616	2505	34903	92812	6416	8522
157.00	1570	1327848	47947	51073	75345	13295394	1803	20959	52362	1703	3507
157.83	1578	716012	39920	50860	43130	15148114	300	7620	26777	1202	801
158.66	1587	298904	31091	36709	90788	14045818	900	3808	8623	1101	400
159.48	1595	238122	32295	37311	38416	16623400	300	1101	5011	100	100
160.31	1603	230385	46748	41425	34601	17866500	601	700	1703	400	200
161.13	1611	196303	35807	39719	36107	14967430	601	1301	2004	400	0
161.96	1620	153582	29386	39419	39518	15307960	400	1302	1101	1201	100
162.79	1628	189456	28483	41725	41926	15968894	1503	1903	1703	701	0
163.61	1636	165934	28783	39719	32897	18206086	701	1000	1101	100	0
164.44	1644	176790	31594	56678	38716	16174431	500	20265	9527	901	200
165.26	1653	273263	35405	40723	40221	16783388	200	1202	1804	400	100
166.09	1661	274350	28282	39217	142557	16162618	500	1703	700	500	100
166.91	1669	259171	48064	41123	55777	13423347	901	601	2305	500	100
167.74	1677	374342	32696	72132	37211	15573316	801	901	2304	801	3208
168.57	1686	333954	29386	48147	54389	14788636	600	1503	1101	800	100
169.39	1694	383596	28483	45037	38415	18265338	300	1702	600	400	1002
170.22	1702	528730	32997	42328	48350	16114707	1101	3207	10630	900	200

171.04	1710	726524	33398	50756	53467	13775170	200	13036	26275	1503	4411
171.87	1719	917120	76548	59186	172874	11173916	1502	59993	123446	9726	10828
172.70	1727	2299184	671588	86587	301106	4855044	3207	134062	86389	8321	9625
173.52	1735	1396736	390656	67516	410016	4079653	2304	25373	54670	17047	19054
174.35	1743	480626	167344	72236	398626	2107327	1803	27379	97633	14540	9926
175.17	1752	520456	137603	47846	343510	3418013	1202	1730168	3718816	84591	11430
176.00	1760	476348	162029	49653	317218	5472275	4209	1379144	2145536	33097	18352
176.83	1768	1341576	319852	69927	358822	6861620	2004	205137	357941	13738	13637
177.65	1777	567284	168448	54971	467280	4483453	900	83579	212491	16044	27181
178.48	1785	383084	156890	266513	543884	3051405	1403	44234	115806	20559	17651
179.30	1793	599508	225651	57782	488954	4977439	1703	120629	283124	17650	12836
180.13	1801	579458	179904	53165	553204	2757652	1703	54470	135092	11531	10628
180.96	1810	538558	136296	66011	547010	3654953	1402	35004	90503	23368	9023
181.78	1818	855572	113497	76952	324966	5095960	801	38416	121936	20056	20458
182.61	1826	1030620	149866	70127	318122	5181860	1001	66913	164026	20458	12534
183.43	1834	1712736	132388	99444	286612	4043490	1000	46140	146042	7720	7118
184.26	1843	674794	53365	38616	102852	819114	700	8823	19655	3207	801
185.09	1851	156601	29989	29185	47043	222093	1302	2304	11029	500	0
185.91	1859	65508	28683	30289	40722	152210	801	1302	1000	1001	100
186.74	1867	51459	27280	26877	39720	117853	600	901	600	400	100
187.56	1876	46241	27279	29687	38716	120222	701	900	400	800	0
188.39	1884	49852	27982	29487	39117	110157	300	800	0	400	0
189.21	1892	46241	23467	24370	38616	115485	400	901	200	600	0
190.04	1900	51258	28684	29587	37713	111333	900	600	200	500	0
190.87	1909	45840	26176	28985	34202	110152	500	801	0	901	0
191.69	1917	50054	28683	28984	35305	117263	501	1001	0	700	0
192.52	1925	45638	24270	26074	37713	110748	801	1101	0	600	0
193.35	1933	45839	25974	28182	38215	112526	300	1201	300	500	0
194.17	1942	50356	27480	26978	33298	108380	800	600	0	701	0
195.00	1950	46040	27179	29085	38415	113111	1202	701	100	600	0
195.82	1958	46842	26176	31391	33801	108374	400	701	0	600	0
196.65	1966	46341	24571	29988	36609	105415	1002	901	100	701	0
197.48	1975	45538	28784	29987	36309	109561	701	1602	0	701	0
198.30	1983	40823	27078	26978	39819	105421	1202	701	0	100	0
199.13	1991	46842	23869	28483	34401	114298	500	801	100	100	0
199.95	2000	46241	24069	25474	38013	104234	500	400	100	300	0
200.78	2008	47344	23367	30690	38215	113117	701	600	0	600	0
201.60	2016	44235	27480	28383	37813	101865	400	500	0	1000	0
202.43	2024	49854	27279	24871	35605	107198	600	601	0	600	0
203.26	2033	48950	25474	27982	37913	108970	600	500	0	400	0
204.08	2041	48247	25173	28283	36509	108380	500	800	100	700	0
204.91	2049	44334	28884	31894	34503	110157	1001	500	0	1001	0
205.73	2057	45138	28282	26076	35205	107789	701	200	0	500	0
206.56	2066	46341	27579	27581	37512	106602	800	1302	0	501	0

Table 7: Left hook carbonate down 30 raw data minor elements

Carbonate Traverse Center

		left hook traverse center major						
Ave blank		**17,976**	**3,278**	**28,402**	**5,000**	**17,924**	**32,673,604**	**3,487**
Trace for Mass:	Distance (um)	Mg24(LR)	Ca43(LR)	Sr88(LR)	Ba138(LR)	Al27(LR)	Na23(LR)	Ti47(LR)
Resolution:		Low	Low	Low	Low	Low	Low	Low
Time	10	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity
[sec]	um/s	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]
0.95	10	17617	3308	28917	4729	18653	31160996	3846
1.83	18	17618	3012	28741	4848	17617	32632362	2810
2.71	27	18210	3189	28799	4967	18061	32568858	3699
3.59	36	18949	3426	27972	4848	18653	32713820	3994
4.47	45	17469	3485	27972	4907	18506	32740470	3403
5.35	53	17617	3308	28563	5084	17617	32667516	3107
6.23	62	17765	3248	28799	5085	17471	32656176	3994
7.11	71	17469	3130	28564	5026	17765	32671296	3550
7.98	80	18061	3368	28740	5202	17617	32699646	2958
8.86	89	17468	3189	28622	4907	17912	32707396	3403
9.74	97	18357	3248	28445	5026	18507	32669216	3846
10.62	106	18506	3367	28090	4788	18652	32620076	3699
11.50	115	17322	3189	28620	5381	17469	32709664	3254
12.38	124	17765	3130	28799	4908	18358	32680746	3699
13.26	133	19395	3367	28090	5026	17765	32627636	3550
14.14	141	17468	3071	28326	4967	16877	32658066	2808
15.01	150	18061	3367	28031	4848	17765	32608736	3550
15.89	159	18803	3308	28858	4908	18061	32612140	4143
16.77	168	18506	3367	28740	5025	17471	32595696	3403
17.65	176	17914	3308	28799	5262	17320	32642756	3107
18.53	185	18358	3486	29390	4907	16580	32629904	3697
19.41	194	17912	3248	28978	4967	17765	32570370	3254
20.29	203	18207	3012	27795	5203	17322	32576796	3253
21.16	212	18506	3485	28149	4848	17025	32554872	3254
22.04	220	3168254	271463	2556190	50860	19985	32788854	3699
22.92	229	7421369	561259	3775299	55711	18803	33027372	3254
23.80	238	8061795	600592	3908473	49561	18653	33033608	3551
24.68	247	8466113	595917	3859451	57543	18800	33139448	3845
25.56	256	7048141	605438	4141368	67538	17617	33124140	3403
26.44	264	8098957	614841	3894227	70436	18653	33225066	3403
27.32	273	7923731	600356	3869799	75225	19987	33035876	3553
28.19	282	7223438	618452	3752642	82620	18803	32975586	3699
29.07	291	6532502	630873	3570187	130704	18209	33136424	3256
29.95	300	7057874	651099	3815768	188070	19096	33034176	3403
30.83	308	7395712	617389	3842795	177840	18950	33147576	3551
31.71	317	6861078	637497	4310594	114438	19098	33023214	3846
32.59	326	7737070	651805	4032150	110002	17914	33213916	3551
33.47	335	7328381	583735	3872114	112724	17766	33180462	3402
34.35	343	6824176	643114	3965764	123429	18209	33180272	3697
35.22	352	6203665	624483	4210920	131828	17766	33143228	3551
36.10	361	7051023	610349	4013203	120826	18653	33341490	3254
36.98	370	6454894	604670	4093575	92910	18209	33048918	3699
37.86	379	6991913	579952	3740854	89540	18210	33001480	3551
38.74	387	6851486	608754	3759565	78894	18357	32925880	2959
39.62	396	7358715	589116	3801877	86758	18358	33092010	3256
40.49	405	8041808	647904	4009801	78007	19246	32985980	3846
41.37	414	7164140	572617	3960164	81437	17914	32900552	3551
42.25	423	7426991	609755	4029126	91906	18210	32966892	3253
43.13	431	8276641	612003	4283614	123901	18655	33044382	3699
44.01	440	7592083	596688	4107041	108109	18061	33096546	3402
44.89	449	7529902	614785	4551664	118106	18949	33077836	3254
45.77	458	6254105	556053	3901244	173819	19690	33551092	3996
46.65	466	4856969	469237	3093623	109884	19541	33427864	3996
47.53	475	6462643	595563	3840220	90249	18063	33247746	3403
48.40	484	6980668	601182	4377075	414823	18358	33083694	3107
49.28	493	7688615	598817	4100851	299023	18504	33250580	3848
50.16	502	6948467	634774	4231828	121416	18653	33094278	3403

51.04	510	7108196	610467	4295332	95101	21319	33076512	2662
51.92	519	7183276	617741	4182169	111069	19098	32993352	3105
52.80	528	6952011	660794	4337668	108349	17914	33015464	4291
53.68	537	6152139	565160	3180504	59613	17320	33111100	2958
54.56	546	5941593	480769	3421963	71263	18060	32968026	3550
55.43	554	7441781	603312	4112546	61150	17914	32992974	3848
56.31	563	7685827	641750	4147771	152762	17914	32887890	3699
57.19	572	7234448	653760	4391439	167371	17912	32752376	3107
58.07	581	5792496	675646	4372633	183458	17767	32740092	3848
58.95	589	7958459	641106	4062532	95633	17914	32961788	3846
59.83	598	7673353	628980	4027118	71442	18506	32877872	3107
60.71	607	7283942	598345	4278251	79603	17617	32720058	4538
61.58	616	7603659	595743	3920474	103734	18210	32877496	3699
62.46	625	7643231	603013	3835991	80256	17914	32796224	3699
63.34	633	7369961	592964	3554913	100422	17469	32845932	3403
64.22	642	7285761	616382	3843481	111600	17765	32834214	3553
65.10	651	7360605	631818	4042828	95928	18357	33004880	3846
65.98	660	7686536	615673	4563949	66593	17172	32903388	3254
66.86	669	8199340	622117	3767077	87291	17765	32828922	3254
67.74	677	7685969	636431	3998177	83625	18358	32751432	3846
68.61	686	7294928	581488	3870437	67005	17617	32826654	3699
69.49	695	7581310	576934	3590055	89896	17914	32728752	3105
70.37	704	7576821	620463	4013557	247156	17471	32844988	3699
71.25	713	7442962	631168	3973513	94094	16728	32806808	4142
72.13	721	7010813	585392	4206431	88713	18506	32676588	3107
73.01	730	6663242	621645	3927467	79309	16582	32712498	3550
73.89	739	8002733	605497	3701140	84453	18061	32768064	4289
74.76	748	7860983	626379	4331337	98943	18358	32547124	3697
75.64	756	8297242	619518	4404149	70140	17174	32529736	3699
76.52	765	7879079	631228	3715551	79544	17766	32672996	3105
77.40	774	7154123	646188	3852836	65351	18209	32448088	3699
78.28	783	8000276	622356	3806602	70909	17766	32544288	4143
79.16	792	7943717	671381	3912678	67833	18061	32485888	3402
80.04	800	8458412	597636	3920593	82383	17766	32528980	3254
80.92	809	8216208	630516	4033780	116213	20284	32719680	3699
81.79	818	7113960	584444	4138840	88298	19688	32637088	3402
82.67	827	8040296	624666	3800412	97111	17912	32570180	3551
83.55	836	6844210	594497	3994988	101841	17322	32705316	3697
84.43	844	7338634	606799	3867436	112487	17618	32599288	3699
85.31	853	7054283	612242	3789474	135791	17025	32635196	3550
86.19	862	7217036	617091	4013439	93443	16286	32634440	3402
87.07	871	6906273	598932	3857041	94803	17320	32713632	3846
87.94	879	7453357	611061	3813311	80195	18063	32643702	3402
88.82	888	7729533	620818	4344779	67184	16728	32481918	3105
89.70	897	7742196	578945	3753044	93088	17765	32458860	3551
90.58	906	8289871	581134	4063429	64344	17912	32625936	4291
91.46	915	7542636	571315	3889597	74162	17766	32408964	3254
92.34	923	7189513	572853	4160906	117515	17912	32689062	3403
93.22	932	7066474	628803	4031536	116923	18358	32670728	4291
94.10	941	7015869	647077	4395502	119346	17766	32705694	3551
94.97	950	6915983	628921	4040655	105747	17025	33332040	3107
95.85	959	7203688	664052	4107443	82856	17766	32585680	3105
96.73	967	7316379	616615	3948376	54410	19246	32583978	3846
97.61	976	6754600	571019	3627005	48021	17025	32383072	3254
98.49	985	6927937	611176	3858081	57127	18652	32471144	3256
99.37	994	7315907	638622	3997208	58135	18357	32607980	3846
100.25	1002	7860227	589473	4111152	71796	17617	32553928	3551
101.13	1011	7998716	627264	3778772	83033	17471	32499684	3994
102.00	1020	8056739	601714	4045994	242483	18949	32518016	3254
102.88	1029	7231565	607570	3995885	126680	18358	32644836	3996
103.76	1038	5923095	363846	1766748	36843	20874	32379858	3699
104.64	1046	1247489	254311	3010144	21525	51674	32435424	3699
105.52	1055	941716	381820	4371854	22531	587539	33448086	3699
106.40	1064	1675402	290152	2373911	40450	715173	34145120	4143
107.28	1073	2500742	268210	2200693	62807	105868	32451112	3845
108.15	1082	4870294	442443	3407481	149688	32276	32431644	3401
109.03	1090	7047361	616379	4110278	184817	22650	34050052	3253
109.91	1099	8592011	632054	4138604	134251	18360	32576228	2959
110.79	1108	7199577	623479	4405779	114320	18653	32568858	3550

111.67	1117	7286517	649032	4075832	123842	17766	32602688	3105
112.55	1125	7741676	572082	3746240	187836	27686	32721570	3697
113.43	1134	2859653	286308	1857232	56775	123342	32683960	3994
114.31	1143	3799420	371946	2748875	76706	133853	32680936	3550
115.18	1152	6486575	561023	3625942	88120	29908	32609116	3254
116.06	1161	10130731	618157	4251272	87411	21171	32606280	4291
116.94	1169	7251718	710596	11529945	91018	19839	32360580	3697
117.82	1178	7472304	670026	5415016	84867	17765	32416524	3256
118.70	1187	8695228	641516	4074415	68307	17469	32496472	3105
119.58	1196	7282028	648790	4176971	81497	17618	32551280	4143
120.46	1205	8467011	657188	3994019	83212	18061	32374376	4291
121.33	1213	8477831	670318	3994421	73453	17617	32414256	3107
122.21	1222	7051826	605556	4187957	57779	17172	32295564	3846
123.09	1231	7105243	639981	3975662	55296	16877	32447332	3699
123.97	1240	7574600	644239	3967465	70671	17765	32276664	3697
124.85	1248	7819804	620050	4093598	57957	17322	32272696	3254
125.73	1257	6835492	605143	3875303	61564	18360	32300856	3403
126.61	1266	7109046	653408	3915868	56716	18060	32215616	3846
127.49	1275	7687481	615611	3929287	79190	17766	32204088	3402
128.37	1284	7659792	609814	3912631	70081	18952	32395924	3108
129.24	1292	8480336	614725	4456880	139278	17617	32329016	3699
130.12	1301	7640231	621293	3834834	128752	18209	32172148	3994
131.00	1310	7807968	656125	3753446	71678	17763	32323724	3550
131.88	1319	7680960	593611	3990901	67125	21319	32310684	3105
132.76	1328	6948443	608400	3904669	79544	17322	32255118	3254
133.64	1336	7612495	578234	3892715	62630	17469	32207490	3846
134.52	1345	8083199	619397	3963472	63280	18210	32154948	3551
135.39	1354	7897460	631050	3781796	83920	16877	32140584	3254
136.27	1363	7729817	615789	4124453	93681	16285	32155136	3699
137.15	1372	6993709	633770	4036709	85577	18063	32340356	3994
138.03	1380	8298092	620759	4265990	111542	17469	32472656	3551
138.91	1389	5017336	643823	5541362	65232	17914	32503276	3105
139.79	1398	4809318	553395	4372562	82501	131482	32132268	3551
140.67	1407	6220699	602423	3998980	177309	33313	32295942	4143
141.54	1415	7058300	636195	3989152	176716	19098	32431076	2959
142.42	1424	7067561	628331	4094425	128811	17025	32380992	3254
143.30	1433	7557590	664052	3974009	122896	17471	32325616	3699
144.18	1442	8242148	598758	3849174	99947	17174	32293484	3697
145.06	1451	7205909	630398	4070706	98411	16580	32406696	3551
145.94	1459	6955838	639033	4453620	86819	17765	32229414	3403
146.82	1468	7782831	655948	4122988	74044	17320	32327694	3846
147.70	1477	6768657	617862	4091756	105035	18209	32323348	3697
148.57	1486	7837310	635958	4136832	130939	16877	32190668	3254
149.45	1495	6604274	627976	4109923	144423	16728	32356612	2959
150.33	1503	6864197	632173	4012683	221722	16582	32201632	3994
151.21	1512	6646799	644180	3837480	470950	17766	32170636	4142
152.09	1521	7546770	625132	4371759	160334	18357	32313520	3254
152.97	1530	6736645	628508	4027590	129402	16877	32221854	3254
153.85	1538	7754670	583854	3770881	81199	17765	32290272	4289
154.73	1547	7185804	642169	4282929	69844	17025	32195772	3699
155.60	1556	7323656	635008	3782410	74575	16579	32231304	2958
156.48	1565	7562126	622649	3939115	73333	17766	32153058	3996
157.36	1574	7001411	606920	3820824	68248	17912	32150600	3996
158.24	1582	6603920	640158	4323115	82441	17468	32265702	2959
159.12	1591	7636923	638386	4308988	77415	17026	32211648	3403
160.00	1600	7623599	672450	4176522	102550	17469	32445064	3550
160.88	1609	8065481	587817	4036190	113373	17322	32216372	3699
161.76	1618	7734400	634243	4065957	114556	16728	32101650	3846
162.63	1626	7566804	630516	3970607	78776	17025	32065362	3403
163.51	1635	7837499	666889	3749855	90308	18653	31976154	4143
164.39	1644	8225847	591006	4203573	278974	17322	31879386	3550
165.27	1653	6885223	615733	4126177	346811	17025	32027562	3254
166.15	1661	7544880	640867	4189067	116508	17765	31957064	3402
167.03	1670	8265679	598401	3964488	109353	17912	32029264	3550
167.91	1679	2136940	124492	522582	14664	16285	31600988	3107
168.79	1688	261933	19040	84985	6621	16580	31317112	3402
169.66	1697	78178	7093	45537	5262	16285	31284604	3846
170.54	1705	50490	4788	32467	4728	16434	31298778	3699

171.42	1714	21468	3960	28978	4611	16434	31406508	3107
172.30	1723	19541	3721	27677	4787	16433	31230172	2810
173.18	1732	17468	3426	28563	4788	16582	31318434	3550
174.06	1741	18358	3071	26909	4670	16433	31228092	3254
174.93	1749	18061	3308	26966	4372	15841	31248692	3254
175.81	1758	17469	3130	25547	4669	16284	31255308	3253
176.69	1767	17174	3545	26138	4731	17322	31235084	3403
177.57	1776	17765	3130	27381	4849	16284	31231684	3846
178.45	1784	17323	3426	26907	4492	16284	31271184	3254
179.33	1793	17471	3130	26494	4728	16433	31266270	3848
180.21	1802	17174	3604	26020	4551	16877	31223368	3697
181.09	1811	17172	3308	26729	4613	15545	31226012	3551
181.96	1820	17618	3189	26197	4551	17025	31215240	3107
182.84	1828	17617	3485	26020	4374	16580	31245480	3846
183.72	1837	18063	3485	25841	4492	16582	31256064	3551
184.60	1846	17322	3189	26137	4315	17025	31143420	3254
185.48	1855	16728	3130	26433	4255	15841	31269104	3403
186.36	1864	17025	3248	26789	4552	17172	31157406	4142
187.24	1872	17172	3426	26079	4611	16137	31154004	3699
188.12	1881	16877	3012	26317	4315	15841	31214106	3107
188.99	1890	17322	3367	26729	4255	16286	31253228	4143
189.87	1899	18210	3071	26435	4551	15990	31132836	3846
190.75	1908	16434	3544	25725	4672	15990	31143988	3846
191.63	1916	17025	3248	26492	4787	15693	31218076	3254
192.51	1925	16877	3426	25841	4254	15988	31153816	3699
193.39	1934	17914	3603	26019	4313	16582	31124898	3402
194.27	1943	16580	3367	26079	4492	16286	31198986	3253
195.15	1951	17617	3367	26494	4434	16433	31194260	3402
196.02	1960	16877	3071	25961	4492	17026	31190292	3551
196.90	1969	17320	3071	25428	4492	15841	31166288	3108
197.78	1978	17025	3485	25607	4493	16434	31159108	3254
198.66	1987	17174	3248	25664	4372	17174	31088800	3994
199.54	1995	16729	3189	26019	4729	16729	31033232	3994
200.42	2004	16582	3071	26612	4493	16285	31096360	2959
201.30	2013	17025	3130	26197	4669	15544	31151548	3402
202.18	2022	17322	3544	25666	4552	16728	31105432	4291

Table 7: Carbonate traverse center raw data major elements

left hook traverse minor center											
Ave blank		**45,961**	**25,280**	**27,609**	**30,962**	**122,001**	**722**	**772**	**43**	**672**	**-**
Trace for Mass:	Distance (um)	Mn55(LR)	Ni58(LR)	Zn64(LR)	Rb85(LR)	Sr88(LR)	Mo98(LR	La139(LR	Ce140(LR)	Th232(LR	U238(LR)
Resolution:		Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Time	10	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity
[sec]	um/s	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]

0.90	9	52261	30890	33600	35205	139181	401	1201	0	901	0
1.73	17	51660	26877	27581	31994	132660	1101	600	0	401	0
2.55	26	49150	23467	30189	33599	132666	901	1202	0	701	0
3.38	34	42627	26075	27981	29286	124368	400	801	0	1000	0
4.20	42	43833	24771	28081	30389	127923	601	500	100	300	0
5.03	50	49753	23669	29386	35004	123187	1201	1102	0	600	0
5.86	59	41624	26677	26277	29386	129701	701	1102	0	600	0
6.68	67	46542	24169	28383	30189	124959	701	1001	0	800	0
7.51	75	46341	26978	26978	32897	119040	901	501	200	1200	0
8.34	83	44033	26075	26177	28783	123777	601	300	0	100	0
9.16	92	49351	24872	28383	29888	119040	801	1502	0	500	0
9.99	100	47646	22664	29788	29989	122590	400	300	100	1201	0
10.81	108	48650	29085	27179	30088	117269	701	1101	0	400	0
11.64	116	48148	22966	27480	29386	121415	100	400	0	400	0
12.47	125	45638	24069	28282	36106	114888	1001	701	200	400	0
13.29	133	46040	25073	24270	30691	122590	1502	701	0	800	0
14.12	141	43231	26777	27881	31392	117263	501	800	0	1101	0
14.94	149	45137	25474	24068	28383	112526	400	700	100	400	0
15.77	158	45639	24371	24170	29386	113701	200	1002	0	400	0
16.59	166	40020	27078	26978	27882	117853	700	902	100	400	0
17.42	174	46742	23467	24570	27681	119625	500	801	0	801	0
18.25	182	42629	27782	27680	25674	116076	801	1101	100	1002	0
19.07	191	46341	22364	27681	31392	110152	1302	701	100	1000	0
19.90	199	45537	24570	28784	27380	111345	1001	901	0	901	0
20.72	207	44233	26977	28181	28281	110748	600	701	0	1302	0
21.55	215	47444	25975	25274	31492	512308	701	11331	43636	1803	100
22.38	224	847244	44635	39518	29285	14316514	400	80465	163626	2204	1201
23.20	232	826084	54570	39819	28182	12747530	901	51459	102953	2404	300
24.03	240	521462	37612	35305	31794	18521150	600	17550	28182	400	100
24.85	249	223943	30088	33599	26277	14822230	500	3006	4611	800	100
25.68	257	195791	26377	38214	29687	16155531	300	2204	2405	1001	0
26.51	265	170257	27178	39920	28884	15498094	500	1602	802	500	0
27.33	273	201113	29084	38715	25775	21118292	500	400	3006	700	0
28.16	282	194178	31793	42629	30288	16621038	900	1503	2304	1101	0
28.98	290	175887	30189	37411	30590	15684638	700	1101	701	300	0
29.81	298	184632	31492	34603	31894	17356626	800	1201	902	1001	100
30.64	306	209862	32897	37813	24671	17547422	300	1201	1803	1502	0
31.46	315	216197	27679	35004	27881	16660161	801	2104	2805	801	0
32.29	323	218911	27580	37511	27179	15519357	1302	1602	3207	900	401
33.11	331	237826	30088	36308	27781	14967477	500	2103	2906	400	100
33.94	339	258739	32597	38314	28283	18297846	500	2105	6918	300	200
34.76	348	450836	30389	35606	30489	16468893	1000	6114	15944	200	800
35.59	356	737248	55272	41324	32897	19754280	400	14641	46241	1101	3006
36.42	364	972092	42226	39818	28483	19151842	600	12635	31794	600	701
37.24	372	996860	36107	40221	27882	18164506	200	10929	23568	1201	1001
38.07	381	442866	33198	43532	27180	16478816	600	4711	6918	701	0
38.90	389	261460	28082	40120	30490	18159876	601	2003	1703	200	0
39.72	397	185534	30088	38314	29686	15920982	801	901	901	801	100
40.55	405	201516	109888	37112	28784	17687092	300	1001	600	600	100
41.37	414	261458	53669	45639	30388	16561976	600	1201	1903	300	0
42.20	422	255222	31393	33800	26878	15842736	601	1001	902	500	0
43.02	430	171264	27981	33399	26878	16723476	0	300	100	801	100
43.85	438	162016	29284	35204	26376	14491292	901	1303	400	600	0
44.68	447	179813	29284	38214	30991	17685392	100	1202	701	501	100
45.50	455	168951	27481	42228	26778	19341316	200	801	901	600	0
46.33	463	164428	25774	55880	29285	18572652	300	701	1102	1000	0
47.15	472	180306	24772	37512	28182	16927880	400	1002	400	801	200
47.98	480	170257	28985	39518	27178	18513400	801	1603	200	1402	0
48.81	488	182516	28082	36006	26376	17566984	800	501	400	400	0
49.63	496	149355	25875	36008	28082	14490630	1202	1403	100	800	0
50.46	505	150360	28985	33198	28584	15478438	901	500	100	700	0
51.28	513	157596	27480	34802	28182	16693898	701	1102	300	200	0
52.11	521	150962	34803	32996	28985	13616978	400	902	800	401	0
52.94	529	133584	28283	31090	26677	14707980	600	1201	0	701	0
53.76	538	156489	23768	32295	27179	13724235	0	1904	1101	901	0
54.59	546	168950	29186	61093	31193	17957174	801	901	1401	300	0
55.41	554	162318	28082	36107	26376	18629540	901	1302	500	601	0
56.24	562	170359	28584	40422	22966	15939410	1001	800	1101	901	0
57.06	571	227860	29987	34602	25874	15374300	1002	1302	2104	1101	0
57.89	579	191161	30289	38715	30990	16692764	500	500	901	100	0
58.72	587	162921	28884	36207	29687	14420747	200	1302	1302	1101	0
59.54	595	163624	23165	32898	28984	14862488	500	1702	3407	800	100
60.37	604	188148	52463	37311	28884	17920508	500	3006	4209	1201	100

61.19	612	176085	62598	39317	26377	17506598	400	2104	3608	801	0
62.02	620	163926	45140	40923	27681	17706748	700	1101	2205	601	0
62.85	628	142425	32395	41826	27681	16609792	500	700	700	900	0
63.67	637	153374	24972	35706	28785	17392724	1101	1403	2104	300	100
64.50	645	228018	29787	35605	28183	16386394	300	1401	3006	1001	0
65.32	653	211776	29185	39920	31895	15499843	600	1602	2104	300	0
66.15	662	200210	26878	35004	25574	16423816	200	2104	3509	1102	0
66.98	670	207749	29586	36208	28884	18532396	800	2404	900	700	0
67.80	678	196390	26777	35205	25374	13870426	700	501	400	800	0
68.63	686	172064	26276	35405	25474	14659502	100	1402	400	400	0
69.45	695	176587	31191	37612	29988	14863810	700	600	1402	800	0
70.28	703	204137	28383	59494	28283	15508206	700	700	2003	400	0
71.11	711	233291	31493	35807	24470	15791800	800	1903	3207	601	100
71.93	719	273837	28884	42328	29988	17316368	400	4411	6416	1402	100
72.76	728	274438	27881	41124	26276	17141732	500	1101	4410	401	200
73.58	736	170963	26677	36308	28282	16969932	701	800	1902	501	0
74.41	744	156690	25273	33399	28884	13512791	400	1203	200	200	0
75.24	752	169254	24671	39117	27680	15174148	701	1001	901	500	100
76.06	761	172467	27278	34702	27881	15807960	700	2706	3407	500	0
76.89	769	159705	27078	39217	28082	15601666	300	1403	2304	900	0
77.71	777	202025	27881	41324	27078	16822418	200	2806	8924	800	0
78.54	785	237112	28483	35003	30088	17035610	300	3608	6817	500	0
79.37	794	230274	29386	40120	29184	14786793	501	3007	8523	400	0
80.19	802	298293	28182	37210	25775	15173582	800	6115	28784	1603	0
81.02	810	475436	35205	40723	32696	14346140	500	9425	52262	800	100
81.84	818	540226	34201	37010	24872	17314006	400	9826	33298	701	0
82.67	827	498034	29687	139884	28984	16575489	300	10328	35906	701	600
83.50	835	583052	38114	35806	26477	24844334	400	20058	42328	1703	2004
84.32	843	706384	36407	35506	27480	21918424	400	16948	49854	1502	1402
85.15	851	427376	26677	33198	27380	16320150	500	6817	13236	500	100
85.97	860	245771	28182	38515	27781	15364282	1001	2405	3608	500	300
86.80	868	194579	31091	46241	26978	16005087	901	2105	4310	300	0
87.63	876	183022	29788	38717	30389	16259764	701	1702	4712	600	0
88.45	885	164126	27179	38013	27981	15098265	200	1303	1001	801	100
89.28	893	133483	29286	37210	23668	14630396	501	1102	400	500	100
90.10	901	131374	27380	39218	25774	16285185	300	500	700	300	0
90.93	909	215901	29486	34803	25573	15264680	700	1100	500	901	0
91.75	918	174074	26477	34804	29587	14568214	400	300	901	901	0
92.58	926	211877	30690	39718	29186	16417958	800	801	200	1201	0
93.41	934	192068	28182	35205	24872	16441488	700	1803	900	801	0
94.23	942	275543	30891	40020	25774	16671974	1001	801	2205	501	100
95.06	951	250299	26678	41325	26175	15102990	401	1403	1703	400	100
95.88	959	243683	29687	35204	23768	17892158	801	1803	2103	900	100
96.71	967	220119	28283	34602	27581	16600248	1001	900	2104	700	0
97.54	975	199105	25473	43633	26878	14642775	300	1001	2205	600	0
98.36	984	209660	31393	36107	26376	16807108	500	2505	1703	400	0
99.19	992	195182	27179	33799	30891	16789816	600	1302	1704	300	100
100.01	1000	179301	30590	36409	23968	17384504	300	1101	3809	701	100
100.84	1008	194276	29586	39117	29386	18329220	600	1301	3006	500	100
101.67	1017	194481	28684	37613	24270	15781784	901	400	1201	600	0
102.49	1025	171763	26277	38515	29185	15929960	200	1001	1000	701	0
103.32	1033	141922	27782	37009	31393	15615274	500	1402	3006	600	0
104.14	1041	157193	27881	39519	24972	17834608	901	1903	1602	200	0
104.97	1050	169252	27580	37110	26176	20821468	801	1201	1502	900	0
105.80	1058	173773	29887	32798	30289	15762884	801	1201	3107	600	0
106.62	1066	239338	54067	46542	25473	17974562	500	1603	6818	700	0
107.45	1074	262662	34302	36007	23568	16416162	701	4410	12433	902	100
108.27	1083	276350	35606	39719	28383	14946120	801	3608	8822	1000	100
109.10	1091	404804	102652	40120	28684	16460672	1803	6115	9425	501	300
109.93	1099	249086	37813	39117	23567	18808996	1001	1603	2606	700	0
110.75	1108	191364	30790	34803	27480	16723476	1302	2104	4411	600	200
111.58	1116	209560	30790	38114	25775	14498284	1001	3608	12334	300	0
112.40	1124	255928	28282	40221	24069	15145704	500	6317	18351	200	100
113.23	1132	366668	33800	43532	28083	14044023	200	8723	23367	600	0
114.06	1141	438026	41726	42227	24972	16410208	1301	9023	32897	700	100
114.88	1149	215703	26778	31092	27179	4328927	701	2806	5212	300	0
115.71	1157	63401	23468	26678	26075	726717	400	1102	1602	100	0
116.53	1165	44235	24872	22865	26175	235128	901	701	300	600	100
117.36	1174	43632	21661	23567	27782	143912	300	500	300	900	0
118.18	1182	44535	25975	23167	25774	117263	400	1301	0	800	0
119.01	1190	43230	24570	22364	25775	111339	400	901	200	400	0
119.84	1198	44033	23568	26276	26275	108976	100	600	100	801	0
120.66	1207	43231	24671	26376	30891	98900	1001	801	200	1001	0

121.49	1215	43833	23066	24671	26577	101269	600	600	100	300	0
122.31	1223	41826	24571	22765	30288	104234	300	300	0	300	0
123.14	1231	40020	24872	28082	26879	100081	501	901	0	901	0
123.97	1240	47144	27481	22464	32597	99491	500	900	100	901	0
124.79	1248	40722	25473	27178	25874	102456	300	501	100	501	0
125.62	1256	39418	22365	27983	25374	103643	500	501	0	400	0
126.44	1264	38616	25976	24571	26878	100081	601	1002	200	300	0
127.27	1273	39417	22263	23366	25173	98894	1202	300	100	200	0
128.10	1281	37512	22264	24571	30892	98900	500	902	0	800	100
128.92	1289	41926	24771	26778	27379	101859	500	1202	0	400	0
129.75	1297	43229	26075	23567	29084	95345	300	600	0	0	0
130.57	1306	45739	23969	23869	27782	101274	800	600	100	400	0
131.40	1314	42729	21561	24069	23768	96526	800	901	0	400	0
132.23	1322	44635	26878	24671	26277	98310	500	700	0	300	0
133.05	1331	46642	23868	26377	25875	103040	500	800	100	500	0
133.88	1339	44234	22565	26577	30489	100081	601	1102	300	400	200
134.70	1347	43029	26376	26375	26175	100081	601	400	100	300	0
135.53	1355	41123	23468	26075	23969	99497	1202	900	200	500	0
136.35	1364	44535	21762	28683	22664	102456	200	700	0	500	0
137.18	1372	47645	25274	25674	27480	97713	600	400	0	400	0
138.01	1380	42829	24471	28583	24772	104228	801	1402	0	300	0
138.83	1388	42227	22966	25071	22464	99497	400	600	0	700	0
139.66	1397	41926	22363	24370	24471	96526	801	400	200	400	0
140.49	1405	46139	25574	23669	22364	100081	400	501	100	1000	100
141.31	1413	44636	26177	29687	25875	101263	200	1101	200	800	0
142.14	1421	41825	22263	24069	25073	97713	600	1001	0	100	0
142.96	1430	39518	22765	28382	22364	100678	400	601	0	800	0
143.79	1438	40421	25674	23667	25674	103046	500	1001	100	600	0
144.62	1446	43732	26978	25173	25774	97128	1201	902	0	500	0
145.44	1454	43430	25774	24269	26476	96526	901	700	0	700	0
146.27	1463	36006	22966	24971	28181	98900	901	1201	100	901	100
147.09	1471	36508	26275	26980	24972	101269	600	1402	100	600	0
147.92	1479	41725	27179	31393	26377	100678	400	700	100	1402	0
148.74	1487	43732	23165	26176	26978	99491	901	1202	0	500	0
149.57	1496	46441	24570	22565	24471	94163	701	601	0	501	0
150.40	1504	38916	23768	25473	26176	102444	300	501	0	200	0
151.22	1512	39417	25173	26076	29386	103637	200	1202	100	701	0
152.05	1520	39919	23869	26376	26678	100678	1001	1502	0	700	0
152.87	1529	42829	25173	25072	28684	100081	401	1002	0	400	0
153.70	1537	42026	25173	24973	25875	95345	300	1101	100	200	0
154.53	1545	40421	27279	25774	26276	97122	100	601	0	800	0
155.35	1554	45940	28583	28985	21560	94754	701	601	0	700	0
156.18	1562	36608	23768	23868	26177	97719	601	701	0	400	0
157.00	1570	43430	26979	24771	23868	99491	600	1402	0	1001	0
157.83	1578	40221	22666	27380	25976	101865	300	1002	0	601	100
158.66	1587	42828	25172	26979	26076	92982	1202	701	200	600	0
159.48	1595	40823	22765	25574	28383	98304	700	800	100	701	0
160.31	1603	42728	22464	22766	26377	99491	700	1602	0	1402	0
161.13	1611	39819	24270	25474	23568	100081	1001	400	0	500	0
161.96	1620	42728	23868	26376	23468	97713	601	1001	300	400	0
162.79	1628	44735	26376	27981	26175	99491	400	801	0	800	0
163.61	1636	43230	25474	25573	27580	100087	600	500	0	701	0
164.44	1644	40922	23167	27180	26477	92976	300	500	100	200	100
165.26	1653	44133	27078	28784	26778	101269	1302	901	0	400	0

Table 8: Carbonate traverse center raw data minor elements

Carbonate Traverse Down 30

Ave blank		**222,993**	**4,252**	**25,307**	**14,635**	**167,118**	**3,852,310**	**1,990**
Trace for Mass:	Distance (um)	Mg24(LR)	Ca43(LR)	Sr88(LR)	Ba138(LR)	Al27(LR)	Na23(LR)	Ti47(LR)
Resolution:		Low	Low	Low	Low	Low	Low	Low
Time	10	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity
[sec]	um/s	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]
0.954	10	268676	4323	26415	14483	221903	4483300	2293
1.833	18	232571	4323	25629	15074	169544	3931870	2131
2.712	27	225841	4192	26351	15534	163800	3920871	1804
3.590	36	223216	4125	25826	14485	170364	3895600	2131
4.469	45	227319	4390	24384	14614	169215	3891358	2458
5.348	53	228468	4521	26088	15207	167246	3885754	1966
6.226	62	225843	3994	25762	14747	169215	3893793	2295
7.105	71	224692	4519	25235	14223	168561	3864751	1969
7.984	80	222067	4255	25695	14945	162978	3864437	2622
8.863	89	221247	4193	25564	15140	169381	3859645	1638
9.741	97	222887	4125	25498	14681	169710	3833745	1967
10.620	106	219276	4321	25237	14223	167575	3842073	2131
11.499	115	219605	4257	25040	13961	162323	3836705	1475
12.377	124	223214	4192	25302	14550	167575	3822223	1638
13.256	133	221410	4255	24385	14878	166261	3799597	1804
14.135	141	222394	4454	25237	14747	164129	3829791	1967
15.013	150	220261	3930	25040	14487	165114	3812874	1802
15.892	159	216978	4059	24975	14550	161831	3790562	1967
16.771	168	219112	3928	24713	14485	165606	3817012	2293
17.649	176	216323	3995	25171	14683	167903	3793679	2296
18.528	185	218783	4390	24844	13896	161011	3788781	1475
19.407	194	239956	51067	856567	29433	185139	3777259	3115
20.286	203	658161	213322	1659509	32184	190061	6498062	3278
21.164	212	1054689	279602	1857506	32250	230273	4687196	2131
22.043	220	684581	180216	1192618	42414	326945	4687039	14442
22.922	229	594807	62210	534353	34022	407366	4512735	4100
23.800	238	527845	22940	176739	21173	509291	5214979	4758
24.679	247	526857	14158	107118	20976	221574	4290141	16409
25.558	256	359281	34677	433791	43789	181856	3857864	2458
26.436	264	1419238	213845	1606865	62145	173977	4149017	2622
27.315	273	1479450	264781	1848838	55720	186285	4296400	2458
28.194	282	1191747	291794	1918922	44118	215995	4180730	1638
29.072	291	1089819	323982	2221865	44445	227321	4277859	2131
29.951	300	1040253	310283	2642934	53689	311515	4533947	2951
30.830	308	1122625	308707	2153149	103251	884820	4665513	3116
31.708	317	726435	208078	2113240	150518	3191196	4604967	3278
32.587	326	347791	203881	2383835	161467	564933	4870823	3773
33.466	335	315946	214371	3212827	187820	392269	4954754	3607
34.345	343	306430	212927	2807484	149534	377333	4852151	2458
35.223	352	341718	192802	2212163	139244	372083	4687537	3278
36.102	361	316276	178707	2197406	138062	204014	4580351	3606
36.981	370	315622	180938	1972737	137342	355831	4618113	3115
37.859	379	290672	171888	1977313	155698	254891	4452163	3280
38.738	387	313979	175888	2272735	184936	338928	4650953	3445
39.617	396	298057	161729	1990721	133671	289688	4478587	3607
40.495	405	296250	161007	3247486	228203	300520	4687170	2293
41.374	414	328586	195426	2812721	206372	626317	4592293	4100
42.253	423	361576	233579	2674202	181396	654768	4750544	6562
43.131	431	431989	197261	2211430	150321	478601	5607268	5249
44.010	440	433790	174970	2323951	133866	1667227	5095747	6563
44.889	449	844770	80435	692545	135966	6282015	4632359	30854
45.768	458	1137906	101347	838781	130392	7646122	4415553	29703
46.646	466	1441517	96367	484007	142192	8895763	4477434	26749
47.525	475	1213895	132489	708280	84566	4844583	4310986	19364
48.404	484	1204049	218631	1360899	56835	1847430	4114240	25765
49.282	493	1234904	262490	1921154	51591	587091	4423567	7547
50.161	502	1050099	276650	2042952	70012	301011	4113088	2295

51.040	510	1213889	288648	1912303	135177	608264	3997705	4429
51.918	519	1339451	170710	877412	133013	3638937	4144958	17230
52.797	528	1433988	175561	754632	98596	5517864	4450697	21827
53.676	537	1709245	196671	1026887	93548	2789859	4153888	13292
54.554	546	1966603	122983	741319	63261	5008831	4199035	63351
55.433	554	449386	24449	75454	22876	1395264	3779380	11321
56.312	563	242745	7143	35005	14550	314473	3637941	3113
57.191	572	221903	5308	27204	14878	209101	3596578	2460
58.069	581	205488	4125	25237	14094	166590	3608664	2786
58.948	589	209759	4388	24582	13830	166261	3611649	1802
59.827	598	206639	4059	25368	13568	158876	3596893	1311
60.705	607	208117	3863	23991	14418	158876	3609554	2458
61.584	616	208117	3928	23860	13632	157236	3600520	2624
62.463	625	204012	4126	23796	13369	158876	3591485	2295
63.341	633	204505	4255	24056	13567	155428	3608533	1804
64.220	642	204176	3863	24909	13172	158711	3589678	2295
65.099	651	206639	3928	23795	13500	160025	3583917	1475
65.977	660	208115	4126	23531	13501	160845	3582633	1311
66.856	669	205652	3928	36383	13960	159040	3599865	2131
67.735	677	206312	3863	24582	13894	159369	3593606	2133
68.614	686	202863	3666	23729	13369	159040	3586719	1638
69.492	695	206146	4323	23138	13370	159205	3572761	1804
70.371	704	205161	3863	23991	13501	156251	3579831	2624
71.250	713	202698	4059	24187	13107	157398	3581455	1638
72.128	721	203848	3666	23338	13239	154937	3567183	1638
73.007	730	205325	4061	23926	12780	157564	3548131	2458
73.886	739	203027	3799	23795	13827	158547	3575563	2296
74.764	748	201223	3995	23926	12845	158053	3569304	1147
75.643	756	203027	4257	24253	14092	154446	3540105	1640
76.522	765	202205	4323	23662	13827	155758	3537971	2295
77.400	774	204341	3732	24713	13172	154773	3546835	1311
78.279	783	202043	4323	23860	14289	157398	3564381	1640
79.158	792	201221	4192	23991	13960	156578	3529748	2131
80.037	800	202207	3797	22813	13763	156742	3563883	1967
80.915	809	203356	3799	23664	14223	156578	3555870	1638
81.794	818	202041	4059	24713	13829	155922	3524026	1804
82.673	827	204177	4650	23927	13698	155266	3544871	2131
83.551	836	202534	4125	22944	13961	158384	3545028	1638
84.430	844	204177	3928	23664	13830	154608	3536334	2841
85.309	853	200400	4192	23598	13369	154115	3528124	2131
86.187	862	202207	4192	23269	13892	155758	3526985	1804
87.066	871	198925	3666	23336	13960	155100	3529420	1311
87.945	879	201221	4190	24646	13567	157726	3535496	1966
88.823	888	206146	4454	24187	13172	155757	3526776	2295
89.702	897	202041	3930	23335	13763	155595	3530101	1475
90.581	906	199253	3928	23991	13238	160027	3513682	2131
91.459	915	201552	3928	22944	13958	154442	3525833	2296
92.338	923	202043	4257	23662	13565	158547	3531096	1638
93.217	932	198104	3928	23204	12845	156742	3521538	1804
94.096	941	203847	3928	24318	13501	155264	3515489	2460
94.974	950	200894	3928	23074	13763	159695	3531070	2295
95.853	959	197446	3864	22942	13305	152310	3525348	1804
96.732	967	198760	3601	23074	13698	154608	3529761	1804
97.610	976	198924	4061	23926	13631	155102	3501020	2458
98.489	985	200730	3928	22615	12714	151982	3516811	1475
99.368	994	198431	3797	23336	13960	156742	3498441	2295
100.246	1002	200894	3928	23402	13434	157564	3491357	2129
101.125	1011	200238	3732	23533	13305	156578	3519731	1967
102.004	1020	200894	3930	22351	13108	154937	3518959	1802
102.882	1029	200894	3928	24056	13238	156742	3496110	1804
103.761	1038	200730	4257	22813	13698	152804	3501531	2131
104.640	1046	194986	4061	23335	12976	151653	3510081	2129
105.519	1055	197940	4192	24056	13634	154608	3508732	1802
106.397	1064	203519	3994	24646	13369	152804	3509557	2295
107.276	1073	203685	3666	23924	13501	157071	3497105	1966
108.155	1082	196955	3797	23402	13305	158711	3483134	1473
109.033	1090	201385	3535	23007	13434	153133	3476260	2458
109.912	1099	199583	4059	22942	13043	154444	3483501	2624

Table 9: Carbonate traverse down 30 raw data major elements

traverse minor down 30 um

Ave blank		**46,162**	**25,695**	**25,925**	**29,178**	**118,488**	**657**	**951**	**43**	**636**	**7**
Trace for Mass:	Distance (um)	Mn55(LR)	Ni58(LR)	Zn64(LR)	Rb85(LR)	Sr88(LR)	Mo98(LR	La139(LR	Ce140(LR)	Th232(LR	U238(LR)
Resolution:		Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Time	10	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity
[sec]	um/s	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]
0.90	9	50956	32798	32797	34201	127923	700	700	0	600	100
1.73	17	45739	24170	25473	30288	126736	501	1101	100	801	0
2.55	26	45739	25675	25473	30690	130292	600	1002	0	600	0
3.38	34	44535	26576	27580	24670	124959	1302	500	0	400	0
4.20	42	51359	25674	26777	27981	120818	700	1002	0	701	0
5.03	50	48047	24671	27280	29586	120222	600	1603	200	400	0
5.86	59	45638	27178	28784	31291	123187	701	700	0	501	0
6.68	67	44435	24671	25574	30892	122584	500	700	0	600	0
7.51	75	45538	28383	26777	29787	119637	200	1000	100	700	0
8.34	83	45739	26476	25374	29988	122000	300	1001	0	700	0
9.16	92	48549	27278	25474	26377	117263	900	700	0	500	100
9.99	100	45639	20157	24168	26578	116076	600	901	100	601	0
10.81	108	46642	25775	23368	29788	119625	500	1201	100	700	0
11.64	116	43731	25573	25372	31493	116666	700	1202	0	500	0
12.47	125	47445	23166	23768	28684	113117	600	1201	100	1202	0
13.29	133	45638	27480	25173	30890	111339	901	600	0	801	0
14.12	141	43332	26677	27479	30490	111339	700	1001	0	600	0
14.94	149	39920	24571	27681	27882	110748	1000	1001	0	701	0
15.77	158	43331	25976	25374	27179	115485	500	1102	100	801	0
16.59	166	46541	25775	27378	27279	111339	900	1001	100	901	0
17.42	174	45237	24471	24169	29989	113707	1101	1401	0	200	0
18.25	182	46642	23868	25975	25675	108380	0	1202	0	300	0
19.07	191	44736	21863	23667	28584	108970	300	1201	0	601	0
19.90	199	42427	22063	26777	26676	107783	400	500	200	100	0
20.72	207	43932	26979	25975	29988	109567	900	1001	0	800	0
21.55	215	201221	35105	35606	27881	9175525	1603	16346	37010	0	300
22.38	224	503952	36108	53065	25674	19804554	701	9024	17650	1101	100
23.20	232	307656	27078	38815	26677	14967997	500	1803	3507	1002	100
24.03	240	255926	29185	32796	27079	13030605	200	1803	5313	1201	0
24.85	249	202219	25272	34302	27981	8579750	200	1301	7118	801	0
25.68	257	185436	25072	32496	25272	7663525	800	1702	6716	701	200
26.51	265	207701	30289	34300	30088	7947167	802	1302	3808	1302	0
27.33	273	191466	28383	145521	28583	13382476	600	1102	6317	701	0
28.16	282	237219	28282	32595	25775	16409074	500	901	2707	600	0
28.98	290	217606	27581	36508	29987	12641548	500	1001	6516	501	0
29.81	298	155383	27580	33900	29085	5599409	700	1002	8120	801	0
30.64	306	117013	24671	412520	27680	2862488	600	800	4610	1101	0
31.46	315	136500	27981	245955	30890	5863560	400	901	5414	801	200
32.29	323	187744	24570	58713	26477	6653013	200	1202	5314	800	0
33.11	331	255634	28283	166469	26978	11555366	1302	1301	3007	700	100
33.94	339	346918	30189	35907	24972	13600912	600	5413	8422	700	801
34.76	348	1036900	34000	40120	28984	14367496	701	26176	73339	2605	5614
35.59	356	1140944	44334	42528	32195	16433456	802	40522	119022	3107	2905
36.42	364	1073144	39317	41224	32094	18552524	901	32195	81167	2806	2304
37.24	372	818448	31292	41123	28383	17287452	300	13738	25273	1101	901
38.07	381	549364	30790	39318	30690	16520396	601	3007	6817	900	100
38.90	389	340782	28283	40421	29386	17695976	700	1602	2004	400	100
39.72	397	319432	27981	36308	25875	15923912	1001	1503	2204	500	0
40.55	405	335138	29988	39016	30790	13903029	500	1602	3707	801	0
41.37	414	419674	31894	43832	29888	15871842	500	2104	6516	801	0
42.20	422	312688	28082	40422	27580	13131342	701	1201	4812	700	0
43.02	430	342992	27379	38815	33499	16321851	500	1101	1702	902	0
43.85	438	312482	25373	34603	28283	15389703	901	1201	1202	300	0
44.68	447	286419	25875	34001	29686	15489212	400	1001	300	801	0
45.50	455	302218	26978	35605	28482	15023610	1602	801	901	801	0
46.33	463	292050	25473	37913	27078	15122079	600	901	1202	400	0
47.15	472	338670	29887	39919	25775	14230094	700	1100	600	500	100
47.98	480	296377	26778	34904	25173	13371230	1301	600	1302	400	100
48.81	488	366674	27280	41225	25273	15680007	300	1102	600	501	0
49.63	496	320334	28182	39318	27179	19932508	1002	1202	1301	900	100
50.46	505	322054	24470	37712	28683	12375673	1001	1703	4511	801	0

51.28	513	205141	27581	33801	24972	6603282	500	1602	2705	600	0
52.11	521	161416	26076	30390	26777	4488845	1101	1702	5412	701	100
52.94	529	98233	24370	25294	25574	1759053	1001	1503	3708	600	0
53.76	538	82171	27580	120184	27981	1558281	400	600	7019	400	0
54.59	546	93816	26477	406005	25976	2083040	200	701	4411	902	200
55.41	554	93314	25272	205005	27480	2387472	500	1301	6315	901	0
56.24	562	114500	26878	245451	29185	3271129	801	901	5815	300	0
57.06	571	141723	27381	33600	29786	8264639	400	1102	5814	600	0
57.89	579	177390	30088	34490	31594	11762084	1001	1803	3709	1001	0
58.72	587	232091	27079	173818	26978	16415406	901	1001	5513	701	0
59.54	595	238725	28583	180076	31092	16502062	1002	1602	5814	700	0
60.37	604	259758	29887	80300	26176	15218564	600	1302	3107	500	200
61.19	612	221425	26376	39819	27079	13492048	901	1402	500	1502	0
62.02	620	204837	28683	31694	30891	14911108	400	1202	300	600	0
62.85	628	186238	25574	37813	28082	15184213	901	601	800	400	0
63.67	637	230478	24772	48653	28684	14802669	600	1402	2404	500	0
64.50	645	286713	31794	37311	27379	14591934	600	2104	1703	300	0
65.32	653	281179	29787	36710	26376	15510568	300	2104	3809	800	0
66.15	662	302326	29285	40420	30790	13604456	600	2404	7220	500	0
66.98	670	272241	25876	32897	25775	10748052	700	1702	7319	901	0
67.80	678	157997	27880	31793	27882	11215402	400	1503	4611	1302	0
68.63	686	219916	24671	50772	27782	10962472	1101	1301	3207	701	0
69.45	695	214795	31091	36809	23266	13372884	901	1302	4510	300	100
70.28	703	247688	27780	36810	26979	12149345	500	2004	13236	600	100
71.11	711	202222	26577	29687	26677	6443979	300	1001	4009	801	100
71.93	719	79159	25473	100359	32396	1403691	1102	500	2706	501	0
72.76	728	72734	25674	711301	27781	1199955	601	1802	3408	600	0
73.58	736	80262	22564	483029	26276	1291165	700	1502	4310	700	902
74.41	744	89206	92500	########	29487	1226610	600	1803	5113	600	0
75.24	752	68421	28984	200608	25675	3788795	300	800	3508	400	0
76.06	761	102753	26276	########	29185	3385463	901	1804	1302	700	100
76.89	769	183018	28383	684867	25774	11188706	500	1101	1904	1000	100
77.71	777	194378	25072	53681	25274	9834757	500	701	2707	600	0
78.54	785	123138	26677	206084	26576	4202226	1000	1301	1803	300	501
79.37	794	150989	25272	171047	26577	1563018	601	1302	4209	800	200
80.19	802	129769	27278	33886	27179	3592158	500	1202	4410	100	0
81.02	810	203027	28684	397692	27078	5785975	500	1603	5915	500	300
81.84	818	315610	27178	317693	25574	11001596	700	2705	9024	600	200
82.67	827	345730	30288	104720	25875	14136397	600	4009	11933	300	300
83.50	835	499856	26778	35707	28984	15513404	801	7520	12935	200	0
84.32	843	591932	26477	68420	26677	16130583	801	18653	39921	900	1804
85.15	851	752380	30991	41926	28487	15592311	601	14340	42528	1202	800
85.97	860	479382	26678	34201	25474	9630448	1001	6315	11531	900	400
86.80	868	265885	30490	34201	29587	6320798	500	2104	4411	1101	100
87.63	876	126853	30188	213409	27480	2410577	501	1402	3207	601	100
88.45	885	77352	22867	296373	33399	1725310	601	600	1001	500	0
89.28	893	75445	24971	414581	27981	1413773	801	800	1401	901	200
90.10	901	91105	25373	126104	27380	2085402	500	901	2806	800	0
90.93	909	146445	26275	636162	26778	4267975	700	2305	8823	901	500
91.75	918	262664	28583	336200	28383	5989670	300	3608	10829	1102	400
92.58	926	154985	27480	168379	28484	3258124	700	1603	3809	600	0
93.41	934	126754	26075	278200	25674	4448021	1001	2305	5915	800	0
94.23	942	167247	26375	126648	27781	7213894	300	1903	4912	901	200
95.06	951	230376	27580	188768	27580	9967435	600	1201	6617	300	0
95.88	959	198298	26979	574324	30689	9229437	600	1402	6416	701	0
96.71	967	273228	26077	82319	30390	13503956	1001	1803	6718	901	0
97.54	975	302130	29386	233805	25474	18509810	600	2705	11832	300	0
98.36	984	368308	29786	41726	23669	17384598	601	7319	31894	801	0
99.19	992	438324	35907	42829	31191	18430524	300	9726	43632	801	100
100.01	1000	426420	29686	41325	25674	16568402	801	8823	37311	1603	100
100.84	1008	350344	39017	41124	28382	16270443	400	3708	21160	500	0
101.67	1017	258546	35003	37813	28283	16307109	1101	2605	15142	802	0
102.49	1025	251798	27179	37813	25274	12777818	100	1202	11732	801	0
103.32	1033	184125	29787	37011	28082	11901802	701	2203	10730	200	0
104.14	1041	183523	30689	46141	24269	8496826	600	2204	9726	1202	200
104.97	1050	223988	28884	128911	27681	5631350	901	1702	10930	500	0
105.80	1058	171163	25374	3181574	22365	8258686	801	1904	9727	1202	0
106.62	1066	237461	28783	469503	25673	8437007	300	2105	12333	901	0
107.45	1074	194481	25372	346915	23668	7441922	600	2606	12234	700	0
108.27	1083	258543	28483	1267499	24069	9550454	600	3708	12936	501	0
109.10	1091	331119	28683	45739	25473	12251830	500	6417	22966	801	100
109.93	1099	556098	33399	73280	27279	13176938	300	13336	34101	1001	200
110.75	1108	413324	33699	42227	25172	14207555	900	10027	31995	0	200

111.58	1116	350362	33599	39417	26877	12342409	500	7520	32697	1000	0
112.40	1124	341680	32797	48448	24972	13785802	801	6818	26275	1001	0
113.23	1132	299606	36108	62608	25374	14616835	600	5714	17449	100	100
114.06	1141	265790	27981	38013	24370	15276586	400	5614	19254	1001	0
114.88	1149	202021	24169	39718	24169	7581759	200	2304	5513	800	0
115.71	1157	77555	28483	29686	26275	1324329	500	1502	1001	800	0
116.53	1165	46040	25374	27380	23969	265332	801	400	100	700	0
117.36	1174	47846	23266	27279	26778	142140	300	500	200	800	0
118.18	1182	39017	26377	25374	26878	110748	902	801	0	700	0
119.01	1190	43832	22264	26978	27581	103046	600	700	0	600	0
119.84	1198	45638	22364	26677	27079	104818	500	901	100	500	0
120.66	1207	40321	24270	26979	29686	100081	801	800	200	700	0
121.49	1215	44434	24270	25473	23969	92970	600	701	500	500	0
122.31	1223	46140	21663	27379	24672	90602	501	501	0	701	0
123.14	1231	41023	24771	25674	28784	95351	300	1102	0	700	0
123.97	1240	46642	22865	24871	28082	94754	400	1202	0	100	100
124.79	1248	41725	24269	27078	27279	98900	701	400	0	500	0
125.62	1256	39217	25273	23468	26176	97128	401	400	100	300	0
126.44	1264	42930	25874	24069	27781	99491	200	700	200	1000	0
127.27	1273	46842	23266	27078	28181	97122	600	801	0	801	0
128.10	1281	40019	23568	25073	24972	95941	100	1101	0	600	0
128.92	1289	40121	23166	27479	27680	98894	300	1101	0	600	0
129.75	1297	43432	25574	25673	26075	94754	900	800	0	500	0
130.57	1306	43933	20658	27279	28683	98304	400	601	0	600	100
131.40	1314	38615	23968	22364	25876	92386	400	300	0	701	0
132.23	1322	37713	22163	26577	25874	98304	600	1302	0	400	0
133.05	1331	39418	24971	27079	25675	97128	701	1001	100	400	0
133.88	1339	41826	23868	25674	25975	100678	0	1202	0	500	0
134.70	1347	39417	24871	23969	28282	98900	1001	1002	200	600	0
135.53	1355	38816	21863	28382	26376	96526	801	400	100	1000	0
136.35	1364	45639	22364	22364	27380	97128	701	600	0	800	0
137.18	1372	43030	26979	26577	27280	94157	901	901	0	701	0
138.01	1380	42227	24269	26777	23869	98894	1101	601	200	100	0
138.83	1388	37712	24170	26577	28282	94163	1001	500	0	600	0
139.66	1397	41725	22966	26176	28283	95345	800	1000	0	400	0
140.49	1405	44033	25874	26376	25574	97122	801	1001	0	200	0
141.31	1413	41726	27279	24671	23868	95935	500	500	0	400	0
142.14	1421	43732	24771	23367	25473	97122	300	1401	300	1301	0
142.96	1430	40922	24171	26578	26777	97122	1201	900	0	100	0
143.79	1438	40723	25674	29988	21963	96532	902	500	0	800	0
144.62	1446	39618	22263	28584	28684	92976	700	1302	0	800	0
145.44	1454	42328	20458	30087	29486	92380	801	801	0	901	0
146.27	1463	45538	26076	27178	25875	94754	500	300	100	300	0
147.09	1471	41927	26176	23065	26476	98304	701	401	0	600	0
147.92	1479	42328	22865	25875	25774	92380	701	800	0	400	0
148.74	1487	41324	23468	24671	22263	97713	1202	1202	0	801	0
149.57	1496	45638	26476	24470	24571	93567	300	700	200	700	0
150.40	1504	45338	25474	24671	27279	95345	600	601	0	801	0
151.22	1512	41725	25975	23668	26979	95345	801	901	0	500	0
152.05	1520	42327	22063	27178	26979	91801	700	1503	200	901	0
152.87	1529	40422	26577	24571	25975	95345	200	700	0	600	0
153.70	1537	43129	21762	23768	26778	93567	600	700	100	300	0
154.53	1545	45538	23969	24570	27279	94754	800	400	100	500	0
155.35	1554	42729	27479	22765	27882	95345	900	701	0	902	0
156.18	1562	42328	26777	25474	26677	91204	701	901	0	600	0
157.00	1570	40723	21160	25273	26777	95935	400	1000	200	200	0
157.83	1578	37512	23267	25172	26677	92970	300	801	0	700	0
158.66	1587	36509	24670	21762	25976	94754	701	601	0	700	0
159.48	1595	43231	26076	25173	25073	95345	600	1302	0	400	0
160.31	1603	44736	26978	26075	26376	95351	500	901	0	800	0
161.13	1611	42629	24069	29186	24670	97122	600	1002	0	601	0
161.96	1620	40119	23267	25975	26577	95345	401	1301	0	801	0
162.79	1628	44535	26677	26276	23267	95935	500	500	0	600	0
163.61	1636	44836	24069	23568	26176	90608	800	1402	100	400	0
164.44	1644	43230	20057	24169	28683	91204	200	1101	0	400	0
165.26	1653	44837	23367	27280	24370	94163	700	400	200	500	0

Table 10: Carbonate traverse down 30 raw data minor elements

Carbonate Traverse Down 60

		left hook traverse major down 60 um						
Ave blank		**18,548**	**3,493**	**28,483**	**4,810**	**17,089**	**32,305,891**	**3,202**
Trace for Mass:	Distance (um)	Mg24(LR)	Ca43(LR)	Sr88(LR)	Ba138(LR)	Al27(LR)	Na23(LR)	Ti47(LR)
Resolution:		Low	Low	Low	Low	Low	Low	Low
Time	10	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity
[sec]	um/s	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]
0.95	10	18950	3426	30397	4967	19838	31528224	3848
1.83	18	18950	3485	29273	4849	16877	32961412	3107
2.71	27	18506	3662	29745	4967	17025	32862942	2662
3.59	36	19393	3603	30042	4790	17320	32741226	3551
4.47	45	18652	3721	29214	5144	17469	32584356	3550
5.35	53	18209	3604	29155	4907	16728	32597396	2959
6.23	62	18803	3367	28976	4966	17025	32501952	2810
7.11	71	18950	3663	28149	4670	18063	32459048	3551
7.98	80	18653	3544	28681	4788	16580	32353208	3402
8.86	89	18209	3367	28505	4669	17172	32342248	2662
9.74	97	18801	3485	28267	4788	17618	32196150	2810
10.62	106	17765	3544	27913	4670	17026	32119604	3254
11.50	115	18950	3367	28326	4670	17025	32219020	2959
12.38	124	18207	3603	28561	4848	16137	32066874	2810
13.26	133	18061	3248	27381	4729	16433	32064416	3551
14.14	141	18507	3603	27911	4908	17469	31999024	3846
15.01	150	18507	3189	27675	4790	17174	32037956	3105
15.89	159	17914	3367	26847	4848	17618	31896964	2811
16.77	168	18210	3248	26850	4788	17172	31870124	3256
17.65	176	18209	3426	28622	4670	16728	31761640	3256
18.53	185	17914	3426	26907	4433	16137	31760694	3107
19.41	194	17023	3485	27144	4848	16876	31795280	3402
20.29	203	18061	3248	26848	4907	16731	31602690	3402
21.16	212	18358	3426	30221	31402	17025	31650884	2811
22.04	220	2384212	133719	996904	251887	9851625	35639352	114603
22.92	229	2668503	176776	1085321	204217	14437048	35553544	177682
23.80	238	2547082	169027	1185975	222196	13090943	33428996	104386
24.68	247	4173923	162759	741651	247095	15399814	33655232	97279
25.56	256	3160092	165833	1230399	211019	14502537	35788472	76402
26.44	264	3924302	189490	1384342	153297	11593544	35468120	43235
27.32	273	2630325	190141	1020677	152942	8476792	33109020	58487
28.19	282	2271237	155188	1455300	171690	11596615	36501192	88840
29.07	291	2998686	245440	1092774	134075	9015347	33370408	43974
29.95	300	5249664	305529	1449104	132595	7058914	36521224	28278
30.83	308	6092699	200432	1001039	155898	9951700	35312004	36275
31.71	317	16284334	248040	974366	107104	6823467	32442416	45604
32.59	326	29361528	254667	1102833	144188	4305397	31967460	30055
33.47	335	25828740	326880	2329732	121949	5236186	32188024	67222
34.35	343	21172442	334509	1753459	125204	5375940	32074812	60263
35.22	352	21225268	330310	1986532	251532	4098820	32169124	33165
36.10	361	8876905	295890	1909810	318481	9773474	32838372	40421
36.98	370	3231156	208002	792152	234440	14042747	33115256	39681
37.86	379	2503116	140461	653698	200965	14648162	34117144	84545
38.74	387	4224890	108226	569363	162463	12247814	35182160	110013
39.62	396	4404622	108938	504961	149629	11401520	34523872	66185
40.49	405	10717292	153295	595090	161456	10720364	33312572	44864
41.37	414	7756277	197475	1166284	178076	10343403	33270048	50934
42.25	423	11098411	199780	810547	200138	6604463	34007336	22947
43.13	431	25177730	271583	1140019	143122	4110112	32483620	16877
44.01	440	31107320	213799	747380	238165	7606919	32731776	42197
44.89	449	21951404	204040	690960	158382	12947634	33131132	117121
45.77	458	24041272	245676	904646	162699	7996354	32422572	45751
46.65	466	15848878	301864	1738729	312863	8805416	32532004	58930
47.53	475	4327604	264426	1450587	217644	7006939	34414256	62630
48.40	484	1719233	397259	1608431	167904	3056579	31845932	22650
49.28	493	2064672	369994	1731630	162404	4732607	35385524	30498
50.16	502	2743571	309019	1403036	169204	6982227	33177628	127042

51.04	510	2322160	172045	887018	197239	9442346	32537296	169983
51.92	519	3078940	158855	757911	186533	11763218	32656932	79511
52.80	528	7757741	240591	1177576	227698	10547476	34234328	57596
53.68	537	14402934	251649	1248912	280336	9204253	32806052	75810
54.56	546	17140694	278323	3291341	427779	8085893	33577928	79807
55.43	554	11703542	227048	2166619	268801	10208126	32460372	49453
56.31	563	3283875	189667	984548	151935	13266194	34160428	100685
57.19	572	2683316	196175	941421	177484	13685915	33051752	151178
58.07	581	3226443	268919	1936553	162993	10217340	32527468	55079
58.95	589	4035505	452200	2715103	219949	4458794	32792068	17174
59.83	598	2419744	387443	3221021	204808	3514136	33463396	15101
60.71	607	2126120	473850	3804310	130053	4094095	32463396	19098
61.58	616	1710332	461724	3735065	76529	2192010	32298020	7401
62.46	625	5432002	370114	2889349	149037	2385546	32483240	16284
63.34	633	3370792	298728	1764374	220423	6224077	35958196	58041
64.22	642	2246064	229174	1378903	222255	9602003	33074622	41753
65.10	651	1924752	127215	662451	232017	13804276	33224876	47974
65.98	660	1809846	123190	574093	181032	11460771	32511402	108089
66.86	669	1966504	162759	853013	152350	10491721	33527466	50934
67.74	677	1752113	144365	903987	136084	9260575	33421248	122797
68.61	686	1521113	156548	1076320	98882	7350021	33756536	39680
69.49	695	1486627	171512	1187989	164886	7091044	34137748	36273
70.37	704	2256418	256678	2428260	219596	7296062	34045516	32278
71.25	713	3391534	288379	1982693	197180	7667163	33033042	95206
72.13	721	2778962	286428	1788578	123309	6494584	32296698	139331
73.01	730	2330311	242424	1036287	131944	9263930	33778456	65149
73.89	739	2240146	148386	1062257	143300	12399109	38003932	38051
74.76	748	3713000	307005	1874089	167608	8992998	37632544	33165
75.64	756	2582047	326347	1663844	125616	7474194	33253228	47234
76.52	765	2329413	361595	1541071	139160	5742836	32428242	272002
77.40	774	1861662	307125	1506177	134841	6896587	33122440	559109
78.28	783	2269607	296597	1420193	143952	7758686	33978800	171907
79.16	792	1991091	254429	1269082	100480	7327365	33687736	92985
80.04	800	2546929	264306	1598792	88888	5108080	32451678	42938
80.92	809	1329367	285657	1775324	209126	4756587	34666000	26206
81.79	818	1651854	279507	1603641	223854	6658210	34285736	27687
82.67	827	1712730	187541	1070177	265312	9837403	32283656	37311
83.55	836	2104799	248872	1698567	159150	7567088	31869748	26058
84.43	844	3109145	389334	2195294	167196	5341306	32166476	16729
85.31	853	3472828	363016	2316254	184877	5577178	32563944	46493
86.19	862	14504522	306416	1489373	99240	4948020	32022836	23095
87.07	871	24166012	297547	1078517	150872	4263037	31540508	26650
87.94	879	10150009	221605	1098628	140284	7791124	32246046	29462
88.82	888	3111531	206939	1071606	126682	9450236	33666760	27984
89.70	897	1347730	129757	654472	77771	13428166	47629512	21911
90.58	906	1433606	149334	1110038	107755	11134084	48368692	22355
91.46	915	2410719	198361	1167884	131470	8494180	34926632	49305
92.34	923	3149874	220954	921142	172043	9246967	32254172	62484
93.22	932	2064672	240944	1029430	135435	9279191	31996376	59077
94.10	941	2786663	294589	2135275	151579	8773238	32345460	42642
94.97	950	3944714	338650	2041484	226220	5993686	32220532	30500
95.85	959	3575419	291631	1482634	217053	9484209	32303692	34941
96.73	967	2941691	183340	1119861	186711	13209541	32099760	96096
97.61	976	2276422	232725	1501198	159860	9884180	31976720	45012
98.49	985	3150760	257388	1531207	140522	8345012	31966516	61742
99.37	994	3715339	368754	2124998	126741	4726985	32222232	37903
100.25	1002	3835590	375967	2077146	121595	5670331	32648804	34497
101.13	1011	4443272	281873	1498782	156074	5271399	33700024	35830
102.00	1020	11669285	302571	1198691	130231	4515659	31954796	48712
102.88	1029	11857813	170624	939531	262000	2852258	31360770	20284
103.76	1038	8101910	230063	1259207	201024	6746166	34073864	41457
104.64	1046	2437675	238875	1971861	251591	10530702	34722512	49453
105.52	1055	2684332	195109	748567	308723	11764919	32488156	51821
106.40	1064	2244883	236036	1080472	205224	12074785	32570936	48418
107.28	1073	5013757	340482	1727767	143419	6895287	33373808	29463
108.15	1082	3374772	318895	1969209	122425	6032927	34239240	99649
109.03	1090	3459492	379341	2013311	144186	6237260	31925312	34794
109.91	1099	3350675	285245	1432963	196647	9225043	31939676	49750
110.79	1108	2166413	312566	1686152	163113	10331543	31689630	90912

111.67	1117	4666363	262592	1302671	128634	6999237	31652208	71516
112.55	1125	4719826	233256	1334376	116628	7167589	32237920	59965
113.43	1134	15836310	295534	1310302	101841	5333769	32410288	60706
114.31	1143	12266289	272705	1150372	178372	5846243	31928336	187752
115.18	1152	4512730	228052	1417518	142472	11287899	34607412	103056
116.06	1161	4512399	336046	1725417	175416	5790393	32094280	22503
116.94	1169	3204070	252535	1490625	180560	7214225	32210514	42789
117.82	1178	4968314	347637	1502869	205932	7396657	32168744	46490
118.70	1187	3705440	202503	947339	203922	13440924	32349428	58633
119.58	1196	2636975	175650	1340093	309138	13227826	33748784	78326
120.46	1205	6456547	237514	1284574	125971	10726222	32066308	277780
121.33	1213	31115826	309374	986314	95572	3083535	31341114	43529
122.21	1222	35543528	280925	710894	169325	4822926	31514048	29316
123.09	1231	33298020	221783	782277	172340	7459074	33561864	37164
123.97	1240	21494780	200374	915699	272114	10121139	32090120	104830
124.85	1248	9816566	209896	1083726	246091	12714597	32251716	57004
125.73	1257	4557121	159210	825623	260405	15562544	34145684	113272
126.61	1266	3267444	163231	771746	177545	16682936	32563756	90764
127.49	1275	7100825	161814	877672	250054	11844299	33183864	82323
128.37	1284	3449097	177604	803920	262178	12196737	32641812	106311
129.24	1292	2465056	136795	1157879	226161	15148634	34589456	313465
130.12	1301	2652792	150634	885955	179969	13681710	33793012	109422
131.00	1310	6072452	130348	469001	177368	13770918	33846876	136519
131.88	1319	10390275	139869	1096338	272470	12347276	34178572	113270
132.76	1328	4734521	182217	1317324	249520	12375720	32682258	57596
133.64	1336	4154941	277437	1969971	229294	7421699	32027562	37754
134.52	1345	3285364	333801	1581056	280336	9891646	32597964	57447
135.39	1354	2558918	167845	990165	235503	12763217	32101084	100538
136.27	1363	2187876	171393	794577	278974	14781501	32203520	70033
137.15	1372	2627336	152408	899020	206406	14523327	32091822	69294
138.03	1380	3403229	218707	1107617	202029	12402274	32170068	111940
138.91	1389	3110361	162344	631697	243488	14148068	32422950	65001
139.79	1398	2313443	142651	640158	196529	13760948	33154002	52117
140.67	1407	2453953	214982	1115661	246800	13234442	32436180	71221
141.54	1415	2333134	252005	1791720	257981	11305980	32990140	50044
142.42	1424	2661250	200136	1225193	173641	11124493	34807184	298063
143.30	1433	1927552	251769	1674971	147382	9734965	38687168	104832
144.18	1442	2681839	177072	892753	152172	13014256	34102784	80251
145.06	1451	1635571	168615	821489	164296	11345906	43434280	260455
145.94	1459	9736146	188665	674695	157790	9540956	36940808	56115
146.82	1468	24213924	228999	928291	114026	5599102	33937596	73291
147.70	1477	14270634	267146	968690	120115	7111125	31624236	145896
148.57	1486	3166471	193632	1053439	120826	9969230	32934384	247425
149.45	1495	3749264	177425	864424	165301	10981325	33439960	96834
150.33	1503	3941430	167844	964668	195642	12822752	32649750	107793
151.21	1512	5432545	185350	1285519	195938	10413664	34512724	80843
152.09	1521	7257884	273238	1592514	169797	8827387	35512912	50194
152.97	1530	4668017	297073	2633018	154657	8888292	31764096	32870
153.85	1538	2374584	500643	3875941	113137	1697007	31264948	10658
154.73	1547	2204461	565577	3841756	120885	543712	31140774	6067
155.60	1556	2743134	533701	3124914	140756	2412207	31091824	12139
156.48	1565	3154469	369994	1854929	152646	5867552	31100896	18357
157.36	1574	2331504	284535	1297467	221902	7691024	31447332	26649
158.24	1582	2140029	213384	1531432	206880	11954770	32384204	52266
159.12	1591	2760605	477752	2104102	152349	5407219	31691898	31684
160.00	1600	8166879	205933	1057408	104976	5313310	31202200	279112
160.88	1609	7362401	405895	2792286	91020	4563500	32927202	95652
161.76	1618	2533474	346338	2258172	110654	6079114	33831756	27687
162.63	1626	1683831	270991	2253742	85636	7214366	39299336	53745
163.51	1635	2273446	357870	2584044	105685	6760270	33483428	22949
164.39	1644	4790347	316175	1551956	157495	8905208	32446196	59520
165.27	1653	4046585	191798	941958	136677	11778480	32016222	75957
166.15	1661	8680439	282582	2022253	120767	7137491	31752188	30795
167.03	1670	4052515	221665	1098923	30339	4043041	32853304	17617
167.91	1679	421996	28208	141644	7271	516614	30394602	5772
168.79	1688	102019	7213	59554	4967	128818	30207870	3699
169.66	1697	42642	4137	31225	4492	55672	30216752	3402
170.54	1705	37311	3722	27439	4551	33462	30251528	4143

171.42	1714	22947	3721	26374	4670	19541	30161188	3699
172.30	1723	18506	3662	25251	4374	19395	30152116	3253
173.18	1732	17469	3248	25546	4195	18358	30183678	3994
174.06	1741	18653	3367	25072	4255	18801	30218264	3994
174.93	1749	17617	3308	25367	4018	19098	30199744	2958
175.81	1758	16728	3071	24836	4254	18358	30069144	3403
176.69	1767	17912	3367	25725	4137	18801	30212216	3994
177.57	1776	18357	3248	25487	4315	18210	30147390	3551
178.45	1784	17617	2953	24540	4788	17617	30156272	3107
179.33	1793	17618	3367	25487	4137	18507	30124710	3403
180.21	1802	18358	3367	25251	4254	17914	30124520	3848
181.09	1811	17765	3426	25310	4552	18061	30075192	2958
181.96	1820	18063	3367	25369	4196	18063	30155328	3700
182.84	1828	18061	3308	26373	4255	18653	30090500	4145
183.72	1837	17765	3189	25723	4136	17468	30208816	3403
184.60	1846	17023	3485	25428	4315	17025	30189536	3551
185.48	1855	17469	3012	25961	4433	18358	30153628	3254
186.36	1864	18357	3248	25251	4195	17914	30093336	3994
187.24	1872	17766	3662	25075	4315	17617	30078784	3105
188.12	1881	18063	3308	25487	4196	17617	30066308	3403
188.99	1890	17765	3426	25310	4018	17915	30067632	3697
189.87	1899	17174	3130	24600	4254	18801	30079540	3403
190.75	1908	17025	3426	25251	4019	17320	30005262	2811
191.63	1916	17766	3426	24895	4254	17766	30062340	4291
192.51	1925	16729	3308	25251	4137	18655	29987874	3699
193.39	1934	17469	3426	25133	4374	18061	29978236	3846
194.27	1943	17914	3485	25369	4196	18653	29945348	3403
195.15	1951	18358	3248	25487	4077	17914	29972754	4143
196.02	1960	18655	3308	25369	4374	17471	29994868	3403
196.90	1969	17912	3308	24481	4255	17766	30000726	3105
197.78	1978	17765	3308	25131	4134	18949	30016224	3697
198.66	1987	18209	3130	24778	4255	18950	29992220	3699
199.54	1995	17615	3308	25369	4134	17469	29943270	3105
200.42	2004	17322	3248	24778	4255	18209	29999970	3403
201.30	2013	18210	3189	25961	4374	18061	29946104	3699
202.18	2022	17469	3189	24718	4136	18061	30067064	3402

Table 11: Carbonate traverse down 60 raw data major elements

traverse minor down 60 um											
Ave blank		**43,718**	**24,241**	**25,832**	**26,656**	**105,246**	**572**	**994**	**57**	**622**	**-**
Trace for Mass:	Distance (um)	Mn55(LR)	Ni58(LR)	Zn64(LR)	Rb85(LR)	Sr88(LR)	Mo98(LR	La139(LR	Ce140(LR)	Th232(LR	U238(LR)
Resolution:		Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Time	10	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity
[sec]	um/s	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]

0.90200001	9	53266	28483	31091	27279	111339	400	500	200	500	0
1.728000045	17	42728	24772	25373	28584	107777	600	1201	100	800	0
2.552999973	26	44033	25675	22866	27179	104824	700	1101	100	701	0
3.378999949	34	39618	22665	28483	25874	110157	501	1502	200	901	0
4.204999924	42	44936	22664	25173	23868	104818	400	1402	0	801	0
5.031000137	50	46643	26376	24269	25172	106596	400	901	0	901	0
5.856999874	59	42427	25473	24370	28182	107187	300	500	100	200	0
6.683000088	67	42328	25474	24972	27279	103643	901	400	100	200	0
7.508999825	75	44033	24972	25674	25072	104234	900	801	200	901	0
8.335000038	83	44033	25073	25875	26677	107783	100	801	100	801	0
9.161000252	92	42929	23869	25875	24169	104234	400	1502	0	600	0
9.987000465	100	41223	21561	24871	26678	103637	801	1202	0	800	0
10.81299973	108	48047	24070	25875	30590	109561	400	1502	0	700	0
11.63899994	116	43130	27480	29286	25373	103637	400	400	0	100	0
12.46500015	125	42428	22465	27982	28683	104824	1302	1201	0	700	0
13.29100037	133	45338	23166	26277	27681	100678	700	1101	100	500	0
14.11699963	141	44936	24070	22664	27882	102456	500	701	0	600	0
14.94299984	149	47244	26677	26076	26577	98304	400	1002	100	700	0
15.76799965	158	36710	21761	26176	30890	101269	601	300	100	700	0
16.59399986	166	45035	26376	27078	25072	103643	900	801	200	600	0
17.42000008	174	40622	26276	24370	27480	104824	700	901	0	501	0
18.24600029	182	43731	22364	21662	28884	107198	300	1000	0	801	0
19.0720005	191	45638	24269	24972	24069	100087	901	500	100	300	0
19.89800072	199	41927	23066	27280	24269	107193	500	1202	0	600	0
20.72400093	207	39118	24872	25573	24370	103637	600	1201	100	1302	0
21.54999924	215	45437	32797	30691	59692	909143	1603	9125	63614	3708	3207
22.37599945	224	748140	123439	48448	137903	7138743	1903	29686	92311	3308	4912
23.20199966	232	570616	71736	41123	125548	5679923	1001	25774	89498	3708	6516
24.02799988	240	749384	84078	44635	263673	3986601	1402	24770	81267	7720	9325
24.85400009	249	735312	97931	54469	441954	2643331	1904	21962	58984	6517	10928
25.68000031	257	478088	111589	70828	412212	2797318	2906	24070	100545	9224	12635
26.50600052	265	476872	101146	56776	186739	3735443	1401	41024	128261	11231	9425
27.33200073	273	950748	96727	54871	139812	11943288	800	52362	155391	9325	7419
28.15800095	282	1214408	113597	59587	245562	13942176	1202	47445	150966	14640	10329
28.9829998	290	905816	110987	57580	280674	5319263	1501	46140	164132	14640	15744
29.80900002	298	634568	118819	63300	300302	4965054	1502	38214	114608	17349	12835
30.63500023	306	836096	130671	59988	235403	5181223	1904	33700	92512	6618	8723
31.46100044	315	2301216	245061	53967	260157	4850049	1001	23668	76750	3106	5413
32.28699875	323	3758832	337658	66919	814304	6905874	500	24470	84183	4410	10929
33.11299896	331	2968448	279265	69624	1215720	6481033	901	24671	73939	4812	7821
33.93899918	339	1830512	138608	64204	989632	7812693	1603	28484	122940	6517	9225
34.76499939	348	1005552	113497	64204	1041028	6131255	1202	35205	91308	3407	9124
35.5909996	356	1225168	131073	75748	890904	5540157	1402	44535	142425	3207	7721
36.41699982	364	1981288	171462	76349	296997	5589321	1001	37210	111890	5212	2505
37.24300003	372	2496800	164528	73338	160008	6459359	901	41726	160610	5212	4210
38.06900024	381	2075272	159808	85784	262867	6162676	1402	43532	142627	11029	9726
38.89500046	389	1262252	116309	76550	251195	4694406	1502	37914	115104	8523	9726
39.72100067	397	849992	158304	87190	298190	5979629	2105	35405	106272	7821	12835
40.54700089	405	701424	138409	91006	363450	4214629	3207	38315	129767	11231	13436
41.3730011	414	506526	109279	86788	242951	5129106	900	24471	98434	5713	5614
42.19800186	422	538306	92411	71531	224041	5449508	1603	38816	149763	13436	9526
43.02399826	430	818280	162020	84279	286013	4920662	2103	50257	145942	11832	11130
43.84999847	438	506308	110584	83676	316847	3669152	1603	34402	98037	12835	9325
44.67599869	447	434990	94619	65911	236819	3726608	800	20960	57078	4210	4711
45.5019989	455	550332	99242	73135	248687	4782622	801	21060	69322	4912	8522
46.32799911	463	698494	131375	67315	273839	3991349	2505	40622	159823	10829	10829
47.15399933	472	667168	173177	63200	266692	4748838	2505	50153	144835	20157	15342
47.97999954	480	730072	294065	70526	371298	4056260	5412	50657	168551	17048	18151
48.80599976	488	870384	186238	64504	386512	3865783	2606	53969	142423	9425	14038
49.63199997	496	465668	113902	51860	274537	2221636	1703	31693	93721	7720	6717
50.45800018	505	258680	76349	45839	113093	1213581	1502	7720	25875	2906	2204
51.2840004	513	199610	55874	35605	82170	1843754	1903	14543	32998	3508	3808
52.11000061	521	916108	141822	48248	152771	2971458	1202	25574	177855	6516	11532
52.93600082	529	1342728	182014	54469	329698	3869929	1402	59088	150261	13136	16947
53.76200104	538	559500	155888	52864	312811	4401220	1001	49555	137408	13335	8623
54.58800125	546	669700	135093	45338	162624	5988489	1202	35405	88196	11331	12936
55.4129982	554	895192	103556	48549	139211	9359705	1804	25374	88496	3910	5915
56.23899841	562	748704	97933	49652	219314	9879786	2204	31794	72334	7318	6417
57.06499863	571	671492	123945	62400	301306	5864174	1302	49653	145742	11732	12033
57.89099884	579	455080	113901	45840	317329	4030449	2003	38515	123541	9425	13035
58.71699905	587	638804	108577	54369	254515	4825288	1501	40722	171379	12735	12132
59.54299927	595	663396	109881	52663	242121	6937340	1101	54370	160110	8823	5011
60.36899948	604	865268	152972	59789	264791	6908616	1703	82573	209062	7018	6818

61.19499969	612	654180	168552	43130	184228	4334904	1402	44938	238300	12735	11531
62.02099991	620	512844	71230	45739	205538	5605929	1503	34603	99036	6918	7319
62.84700012	628	592362	65911	40421	154882	4609096	800	32396	103456	6517	5614
63.67300034	637	606792	111890	52061	204134	6592060	1101	33399	96827	7017	5414
64.49900055	645	694264	88997	45538	134288	7348391	900	31796	74944	6115	5614
65.32499695	653	830532	154782	43732	118419	8595720	2305	42227	124545	9124	6616
66.15100098	662	608408	67918	38013	101347	9266150	1302	34302	82873	7519	3407
66.97699738	670	677138	47645	34903	93716	7729202	900	26276	62397	4210	3408
67.8030014	678	569060	47145	40019	110285	6949766	1001	19355	49252	1803	2305
68.62799835	686	532202	85385	156028	110685	6506727	1002	25976	104761	3407	3508
69.45400238	695	603956	62898	43632	131474	7876670	2004	43430	165033	13237	3708
70.27999878	703	483000	67014	45639	165333	3729537	1001	27681	88395	4912	2805
71.10600281	711	472538	110003	48047	140321	4104466	1202	17650	62598	3709	4311
71.93199921	719	460512	108576	55072	143630	5273053	2003	27479	109684	4710	3507
72.75800323	728	638656	155186	55372	175584	3244492	2806	72737	229319	7620	10128
73.58399963	736	435210	87189	68419	251900	5216164	1403	100254	189362	9826	8221
74.41000366	744	306248	99741	62698	447998	1634082	1002	73841	177312	59287	136599
75.23600006	752	245022	83577	53165	415354	1135400	901	63904	136404	16445	37310
76.06199646	761	386924	79460	57780	333226	2580559	700	30389	81074	7820	10830
76.88800049	769	253915	58584	51358	175983	4574137	600	16746	39118	3207	4812
77.71399689	777	201214	61394	48950	154083	1227201	701	12033	40120	7320	5112
78.54000092	785	478146	78658	54269	202327	2479255	1503	24370	77754	6819	9225
79.36599731	794	468586	62197	147904	152878	3395539	901	25273	111314	5814	3808
80.19200134	802	675260	72132	67220	197803	7876468	1803	139413	536788	42026	11832
81.01799774	810	473736	65911	45136	151667	11715826	1402	54067	172166	9826	5514
81.84300232	818	450018	78355	43030	236108	5190129	1402	28082	86688	9324	7519
82.66899872	827	812836	90102	48047	232889	8759772	600	30790	88695	6316	5413
83.49500275	835	655204	74140	48046	209373	7311040	901	27279	84480	4311	4911
84.32099915	843	898936	75044	51460	176900	8101769	901	46643	151570	3207	3808
85.14700317	851	845120	64003	39819	140216	10634321	700	38916	126152	7520	4811
85.97299957	860	965388	64505	52865	111690	12488789	1302	41123	119723	5715	6015
86.7990036	868	762768	66813	57379	108275	7318175	1202	28784	76650	4210	4411
87.625	876	585118	69423	45338	135693	6374710	1101	102151	232889	7920	7922
88.4509964	885	506828	70326	38315	141220	4962715	1302	45037	115304	11933	9626
89.27700043	893	439528	99544	40422	171664	6793983	1000	27881	75446	8923	6215
90.10299683	901	368276	67115	38214	144233	4418986	1202	16144	56476	3408	3509
90.92900085	909	402948	54569	43933	81569	7639144	1202	15644	45739	1703	2505
91.75499725	918	471950	38014	33800	42830	5143328	801	10629	21661	1403	1502
92.58100128	926	369218	64406	32897	34904	3703502	2606	8021	19655	1301	900
93.40699768	934	258957	46943	34703	61093	3975946	1201	11431	29887	2405	1703
94.23300171	942	549430	59387	43332	95421	9667822	500	24270	73542	4111	2305
95.05799866	951	472320	68318	46140	149859	6962193	901	55674	167147	7921	2806
95.88400269	959	475556	74743	48850	139711	8982461	901	40722	125676	9927	5714
96.70999908	967	505526	72836	47747	167241	6103401	1100	32396	85985	8322	14943
97.53600311	975	341686	70226	46642	157222	5014206	1302	17349	44435	2505	2806
98.36199951	984	477412	57380	47746	101149	5055656	200	16446	84382	2405	4209
99.18800354	992	643742	60691	47645	118819	5363088	1102	27178	101347	4009	5313
100.0139999	1000	877544	61896	56476	101045	9206379	1904	55574	128266	5413	1402
100.8399963	1008	790020	146050	52061	119325	8265821	4912	36008	89097	3006	2605
101.6660004	1017	1132848	359858	46140	85282	6895901	8923	34202	69524	3408	1803
102.4919968	1025	787956	281290	43631	117214	3989201	6818	282060	257733	3709	600
103.3180008	1033	297390	204245	34602	83777	1648479	6617	204840	289333	3408	701
104.1439972	1041	517746	251204	40923	67415	3107680	7821	137214	106569	2404	901
104.9700012	1050	563364	128873	41223	97230	3951092	4309	33299	64907	1603	1703
105.7959976	1058	646556	114601	53166	122538	6438073	7719	56777	131085	3307	1603
106.6220016	1066	824868	240539	51058	113899	9948344	14841	140319	471108	7119	2906
107.447998	1074	1209076	539742	58182	137310	9174344	9927	49151	104862	3909	1602
108.2730026	1083	920768	155889	46842	108580	12936483	2505	31292	65308	3809	2806
109.098999	1091	777532	76250	45137	91306	10613626	1001	29587	76048	3408	4010
109.9250031	1099	535680	56677	39518	65810	6326657	2204	27480	64305	2004	1503
110.7509995	1108	679030	90105	35204	46040	5190129	16746	17248	51760	1201	400
111.5770035	1116	1031552	887968	97224	35707	3360597	57782	12134	30489	1402	701
112.4029999	1124	1623064	1095064	41224	27079	4021566	39218	10428	31793	1202	900
113.2289963	1132	539832	303135	39518	24771	6680323	62097	13837	66515	901	601
114.0550003	1141	738352	467212	45639	26778	4769014	72334	20257	110685	1402	300
114.8809967	1149	631088	257756	122396	21662	5630806	29386	15944	47244	1202	500
115.7070007	1157	240054	52463	230239	25775	812015	4912	3307	7520	500	0
116.5329971	1165	100375	29487	26075	28584	212619	1503	800	2004	800	0
117.3590012	1174	46843	23167	26276	25073	155169	400	500	801	1001	0
118.1849976	1182	43130	24270	24671	24270	117263	701	1301	500	1002	0
119.0110016	1190	49251	25573	26577	24170	98310	701	1001	0	500	0
119.836998	1198	40622	25976	24370	23366	96532	1101	800	100	500	0
120.663002	1207	42929	27981	23668	26678	97719	801	1101	200	400	0

121.487999	1215	42627	23367	27580	26778	95935	200	1202	0	800	0
122.314003	1223	40622	25473	25775	24771	97122	400	300	200	500	0
123.1399994	1231	44234	24872	25474	28985	93573	801	801	0	1201	0
123.9660034	1240	40220	26576	22866	23567	95345	701	1001	0	601	0
124.7919998	1248	37914	24572	27280	22966	92976	500	1101	0	600	0
125.6179962	1256	42728	26578	24069	25373	96532	801	1001	100	800	0
126.4440002	1264	42026	27981	26678	23367	94163	801	400	100	700	0
127.2699966	1273	42026	23267	24772	26777	94748	801	901	300	400	0
128.095993	1281	44635	23267	24470	24269	95935	400	700	100	701	0
128.9219971	1289	45940	22865	26276	27881	97713	600	1101	0	300	0
129.7480011	1297	40220	23266	26476	25974	98900	1001	901	0	801	0
130.5740051	1306	42127	24270	22765	24370	90608	902	1302	0	400	0
131.3999939	1314	40020	24269	28784	25575	98310	700	700	100	200	0
132.2259979	1322	39116	24270	26176	27480	95351	800	400	100	701	0
133.052002	1331	41525	24772	24169	25875	98900	600	1302	0	200	0
133.8769989	1339	39318	21260	23767	24471	93567	700	701	0	501	0
134.7030029	1347	38213	21863	26677	25173	95339	500	901	200	701	0
135.529007	1355	42929	22263	27379	25173	90017	100	1102	0	300	0
136.3549957	1364	39217	29184	24671	25272	92386	500	700	0	1001	0
137.1809998	1372	39920	22765	26276	26477	97719	1001	801	0	700	0
138.0070038	1380	44936	25473	26577	26878	99497	300	1002	0	400	0
138.8329926	1388	41023	23167	24572	26175	94754	901	400	0	700	0
139.6589966	1397	42128	23367	25473	25674	95351	800	1002	0	700	0
140.4850006	1405	41224	24270	25374	26277	95941	100	901	0	1101	0
141.3110046	1413	42929	24872	23868	23668	94754	900	1202	300	1001	0
142.1369934	1421	38816	23067	24169	25071	96532	902	700	0	500	0
142.9629974	1430	40421	26075	25274	24370	91789	801	701	100	200	100
143.7890015	1438	41022	25374	26076	25975	94157	300	1101	0	800	0
144.6150055	1446	42427	26476	25273	26476	92386	1001	1201	100	600	0
145.4409943	1454	42027	24069	24470	24772	94748	700	801	0	400	0
146.2669983	1463	39117	24670	28283	23969	92386	900	1000	0	600	0
147.0919952	1471	47345	25675	24772	24671	95345	701	1401	100	100	0
147.9179993	1479	42026	23267	28082	23467	89427	801	801	200	800	0
148.7440033	1487	45237	23768	23769	25574	91198	801	901	0	601	0
149.5700073	1496	40822	25674	23567	26176	97122	400	500	500	1001	0
150.3959961	1504	39819	25072	22664	24571	95941	1102	1001	0	700	0
151.2220001	1512	43934	22765	23368	25173	93567	1102	400	0	801	0
152.0480042	1520	44033	21762	26075	26075	94748	700	300	0	700	0
152.8739929	1529	43130	26377	23267	24972	97713	200	700	200	600	0
153.6999969	1537	40020	23066	22363	22665	91789	400	300	0	500	0
154.526001	1545	45037	24771	24270	27882	95941	901	801	100	1302	0
155.352005	1554	41524	25475	25273	24971	88239	600	400	0	601	0
156.1779938	1562	40421	22966	24771	26075	97122	400	400	0	500	0
157.0039978	1570	42829	22263	25674	23167	92386	300	1303	0	400	0
157.8300018	1578	38415	22464	22565	26578	98304	400	200	0	200	0
158.6560059	1587	40320	21562	27580	23067	94163	801	500	100	600	0
159.4819946	1595	40120	25775	28484	24070	95345	200	901	0	200	0
160.3070068	1603	43832	24570	24270	23568	96532	701	701	100	700	0
161.1329956	1611	41526	24872	25473	22966	92386	901	800	0	700	0
161.9589996	1620	40120	25774	25976	24871	92386	800	601	0	1001	0
162.7850037	1628	44836	25273	22965	29185	92386	400	1202	400	600	100
163.6109924	1636	42729	26276	28985	24872	93573	500	1102	300	801	0
164.4369965	1644	42128	24471	23366	22464	90011	500	1101	0	600	0
165.2630005	1653	47746	23769	25874	23667	95941	801	501	0	600	0

Table 12: Carbonate traverse down 60 raw data minor elements

Carbonate Traverse Down 90

		left hook traverse major down 90 um						
Ave blank		**18,960**	**3,519**	**28,385**	**4,801**	**18,654**	**31,604,593**	**3,285**
Trace for Mass:	Distance (um)	Mg24(LR)	Ca43(LR)	Sr88(LR)	Ba138(LR)	Al27(LR)	Na23(LR)	Ti47(LR)
Resolution:		Low	Low	Low	Low	Low	Low	Low
Time	10	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity
[sec]	um/s	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]
0.95	10	19098	3485	29686	5085	22060	31292164	3699
1.83	18	19542	3603	29567	4966	18803	32348296	3253
2.71	27	19393	3603	29985	5026	18653	32192560	3256
3.59	36	18504	3603	29330	5023	18504	32112234	2661
4.47	45	19690	3544	28740	4611	19542	32055912	3550
5.35	53	20282	3781	28681	4788	18655	31900932	3105
6.23	62	19393	3485	28208	4433	18358	31864644	3254
7.11	71	19246	3486	28384	4967	18655	31767876	3105
7.98	80	18653	3544	28031	4966	18653	31619888	3402
8.86	89	19393	3721	28799	4729	18653	31615542	3105
9.74	97	17914	3426	28563	4788	18357	31493070	3402
10.62	106	18358	3722	28622	4790	18803	31473036	3994
11.50	115	18653	3544	27500	4788	18801	31411044	3550
12.38	124	18950	3367	27736	4849	18653	31389876	2958
13.26	133	19246	3308	28917	4729	18950	31342248	2958
14.14	141	18506	3367	28031	4790	18358	31234328	3551
15.01	150	18652	3367	27854	4967	18210	31183676	3402
15.89	159	18801	3603	27380	4907	18358	31209192	2959
16.77	168	18506	3485	26966	4729	18507	31150602	3107
17.65	176	19247	3248	27854	4788	18803	31123952	3697
18.53	185	18506	3485	27145	4610	18950	31124142	3253
19.41	194	18506	3544	27322	4552	18801	31092390	3256
20.29	203	18653	3308	27145	4492	18652	30967650	3846
21.16	212	19096	3426	28505	48732	18950	30993920	3402
22.04	220	1838870	116036	675994	241715	9366273	33054020	67073
22.92	229	2586170	165480	992649	222432	13087778	33357556	199302
23.80	238	1792216	160866	931673	207175	13227070	33781860	84250
24.68	247	2163601	222849	1056460	172104	9847892	33169312	56264
25.56	256	2048666	285126	1052612	109057	7585326	36754452	39532
26.44	264	1813242	246564	710652	123250	10398874	34852544	201964
27.32	273	1072315	137503	457879	158085	15066796	46469996	52709
28.19	282	2067483	167489	995664	307126	13898304	42967260	75808
29.07	291	4023503	162286	1044331	281223	13977590	34114688	74772
29.95	300	3488645	228820	1114362	159684	9693479	33834780	83212
30.83	308	2844108	347047	1643373	149629	6041976	32331474	60854
31.71	317	2658297	346399	2087068	125616	6402328	32554304	70479
32.59	326	5154881	341074	1542907	85638	4177467	32406884	46639
33.47	335	10788923	404535	1440765	121951	4118830	31779028	27539
34.35	343	12090992	375790	1621502	159092	4113231	31606280	25020
35.22	352	24401600	278264	1068582	142887	4356356	33960656	341598
36.10	361	21694082	279506	2552575	193214	4388202	36632924	83510
36.98	370	7514829	328712	1852803	145904	4629248	34793008	180644
37.86	379	2966261	282227	1626286	214096	3974458	31752944	67665
38.74	387	1807620	271343	1370858	147915	5356260	31499874	47823
39.62	396	2696191	314756	1602980	188901	6677181	31587192	43678
40.49	405	3225380	304348	1973621	129047	7415321	33462260	67814
41.37	414	2589135	146494	836095	116864	13407329	41460176	71368
42.25	423	1237714	117337	861403	375120	15114992	47420100	32722
43.13	431	2350605	207116	977626	170034	10423208	35505728	42642
44.01	440	2000423	306003	2276328	100008	7168912	33744248	19099
44.89	449	2226515	533819	3822053	114615	1201438	31613274	7399
45.77	458	2727861	653287	3966661	86109	330639	31416148	4143
46.65	466	2732172	574566	4383666	67479	200339	31317300	5772
47.53	475	2802941	579297	4425908	65173	54488	31462264	3846
48.40	484	2395894	570724	3889904	59080	151619	31560732	3996
49.28	493	2638145	577764	3857136	54290	24725	31448844	2662
50.16	502	2758243	558244	3738491	90681	26946	31491558	5624

51.04	510	2596848	531450	3895763	50741	55228	31441284	3846
51.92	519	2900973	538907	3866657	57663	163171	31504788	4883
52.80	528	2336383	510161	3495177	58370	545191	31897340	18358
53.68	537	3784950	473079	3154174	93797	2148481	31722516	11844
54.56	546	5585777	419615	2587009	91727	3184544	32595128	12731
55.43	554	12351670	383422	2041413	271521	3733577	31427108	21615
56.31	563	5515020	261704	1309587	199072	11193761	31971428	92691
57.19	572	3203763	270812	1558760	159978	9158515	31595130	42789
58.07	581	2722096	211196	1252397	146968	11536844	31743684	38642
58.95	589	2259979	339775	2464749	118341	7409556	31222800	92541
59.83	598	1812510	465451	3833487	124019	4942256	30864834	37016
60.71	607	2047791	271463	1327099	594854	13376711	34074244	55820
61.58	616	2240725	129283	852414	429901	17542318	35743112	49156
62.46	625	1658534	256854	1931226	198243	9034909	31380048	25319
63.34	633	1836802	415710	4217015	158679	4808704	31044384	34054
64.22	642	2610303	373544	1844640	159978	7872937	31597020	63223
65.10	651	2959906	390459	1882794	113554	7508545	32480028	56560
65.98	660	2304702	300325	1452949	114973	7366748	34902064	31535
66.86	669	3031288	297189	1492214	143359	7155587	33655420	24282
67.74	677	1997305	223912	1057880	159150	11097749	32111668	80845
68.61	686	2592241	170744	878561	153413	11388715	32703236	130596
69.49	695	2806071	210013	976847	164178	11486617	32128866	110753
70.37	704	2470833	130584	774463	247512	12098410	33465284	66628
71.25	713	4480576	215041	944144	203389	11169050	31868424	57744
72.13	721	2873131	187126	1589207	238933	10856727	32067252	88247
73.01	730	2288105	261408	1532436	190850	11605734	31990708	100536
73.89	739	2949983	305234	1696842	157317	8681762	35483048	60409
74.76	748	2975734	325873	1929229	131532	6529808	31755212	62631
75.64	756	1658806	161043	1035519	195997	9659884	32696622	146292
76.52	765	1995226	212557	1522679	158382	11134226	32718546	74478
77.40	774	2175284	390044	2011657	157969	7704774	32259654	38348
78.28	783	2391913	266909	1432785	143893	10126620	32081616	55376
79.16	792	3350509	244731	1203003	132123	8835561	31704560	57449
80.04	800	6572333	270398	849638	195464	9043366	32215616	111495
80.92	809	3657410	169975	1124417	252359	14195601	31883166	116826
81.79	818	4569430	165242	962305	236331	14307867	32022080	133261
82.67	827	5866489	204808	1001039	140285	12146841	35416332	54487
83.55	836	3805681	299438	1833412	136321	7778366	34032284	73587
84.43	844	5341873	439249	1904317	138806	5288456	32304258	70627
85.31	853	3513841	318125	1266005	119761	5681884	32519340	43086
86.19	862	3852883	157673	984365	89363	7546203	31247370	46491
87.07	871	9886448	259398	796939	104267	4804876	31034178	54785
87.94	879	8412154	395073	1162740	181625	10283726	32389876	128226
88.82	888	3853639	219122	1382039	178372	9510669	31893750	114603
89.70	897	2569609	184818	894053	200728	12924576	31925312	71960
90.58	906	1859004	155957	746024	176953	11571950	31735556	85137
91.46	915	2250943	165006	848578	123724	7077389	31391010	54042
92.34	923	1037820	245322	670144	111956	5471030	31507056	33460
93.22	932	1610989	175355	1359861	151463	9427745	35014140	70775
94.10	941	2050461	199073	1776529	185291	13068830	37638216	186124
94.97	950	1694952	260048	1754570	175122	10410592	35022832	54634
95.85	959	2030321	440137	2060632	133010	4853709	31722704	24873
96.73	967	1753891	201793	2113745	192566	9117502	34633684	30352
97.61	976	2619505	196057	1165929	197121	12217338	32940054	78029
98.49	985	2403017	232665	1592402	161576	10805555	32492880	59966
99.37	994	4014596	204513	1076509	125084	8126197	31037768	46493
100.25	1002	6178457	254370	2281317	131768	8290391	31185756	31832
101.13	1011	3584007	268624	1116907	154893	8630780	31659390	41310
102.00	1020	3229384	207057	1051726	120530	10593922	36942320	33314
102.88	1029	4106545	414411	1440582	113137	3202286	32348484	11991
103.76	1038	1991387	401337	1204202	226871	4953525	30863888	24133
104.64	1046	1843612	208121	838936	211788	10660120	33573392	64260
105.52	1055	2936647	261588	1294095	173167	8481280	31935140	74183
106.40	1064	4699273	287488	968867	170034	8948300	31879764	37754
107.28	1073	2810643	109471	1207686	399921	12659031	39258892	31387
108.15	1082	1824949	277908	1681775	184879	9382102	36931544	31683
109.03	1090	2758089	229589	1724767	235622	10229956	34135856	49156
109.91	1099	2278053	237397	1472936	413582	13041142	34999400	214849
110.79	1108	2216002	179259	1071541	281635	13337210	33040412	288291

111.67	1117	2223266	251355	1691231	232311	11734490	32777324	101277
112.55	1125	5375916	303578	2052363	271522	9076016	32896206	72256
113.43	1134	2201496	272882	1881082	293938	8858666	35675264	40124
114.31	1143	2556851	84040	788895	89539	15311740	55412912	37162
115.18	1152	388534	34182	375553	79308	16544398	57235248	39978
116.06	1161	1898257	196232	1306634	111895	12253012	45717776	42938
116.94	1169	3837669	252420	1080649	187066	7533871	38891476	53893
117.82	1178	5521541	236036	963605	210310	9601247	32224688	42345
118.70	1187	6179213	305293	1109802	172576	8647270	32173092	42050
119.58	1196	2935324	286840	1223952	241656	11003911	32969916	49453
120.46	1205	2285754	240473	1190889	232074	9291051	33173658	41753
121.33	1213	4537300	222079	1215790	370703	11681665	32982390	114900
122.21	1222	10933414	185648	1051313	235148	10677460	32214104	91061
123.09	1231	13205997	184643	830770	215454	9424060	32938352	48563
123.97	1240	7222234	228110	1018486	208240	11467244	32504788	66630
124.85	1248	3192659	226986	1036175	172220	11524795	34967080	71813
125.73	1257	3544920	252125	1185568	230299	10470884	33589648	64111
126.61	1266	2948955	315998	1754700	235445	8634843	31646348	36127
127.49	1275	2666578	302571	1991741	250171	9517615	32433156	45010
128.37	1284	3494445	254431	1701585	194341	9990871	32009608	78029
129.24	1292	2283380	192271	1404394	271581	10632715	35378344	55820
130.12	1301	2820872	151046	1003761	177427	12137060	41834960	49158
131.00	1310	2112205	191265	655473	214568	12617309	39840064	47380
131.88	1319	2321121	134902	749923	206996	13073886	33142096	79362
132.76	1328	2297449	213266	1127367	292814	12043080	32079916	58190
133.64	1336	2644063	250173	1443671	238756	9814912	32628016	157100
134.52	1345	3629922	284770	1728854	320494	9685069	32884300	943057
135.39	1354	3310666	255671	2167098	484020	10094962	33231304	137406
136.27	1363	2594179	177781	943494	269688	13084895	31754268	126153
137.15	1372	3029800	237101	1447096	246267	13328894	31812102	61742
138.03	1380	3346824	248042	1179779	194931	10896748	31424274	46194
138.91	1389	2529175	249995	723427	221369	9893110	31405940	54488
139.79	1398	2419744	213208	1154637	212911	11625437	32448088	66778
140.67	1407	3821202	208476	1220810	262827	14117828	31525956	68554
141.54	1415	2477648	194103	1269371	222967	12403786	32510080	72405
142.42	1424	3338224	246621	1490318	184700	12405676	31218452	122750
143.30	1433	2594746	168377	1079698	314223	14751356	31934952	131188
144.18	1442	2269300	173818	1660666	321677	13806922	33407262	125709
145.06	1451	2696357	225865	1149132	199606	14498757	31831758	81435
145.94	1459	2735586	224919	944262	202147	13160354	31664492	117418
146.82	1468	2597876	210841	1103949	227343	12950138	31585302	74032
147.70	1477	3200077	249994	1195029	225214	11818123	31765986	77735
148.57	1486	3441997	297545	1701112	247983	9578189	31759560	62484
149.45	1495	3254131	283115	1515875	273947	9910404	31725162	35681
150.33	1503	2771106	216875	916172	287846	13668433	31843098	62038
151.21	1512	2948802	168849	1113824	275188	12843117	32205600	54044
152.09	1521	1772525	226692	1223119	188486	8673635	31266460	35238
152.97	1530	2255396	301803	1283269	164474	6677016	32734988	45305
153.85	1538	2211418	271817	1875388	331553	9193149	31747464	114457
154.73	1547	2700787	411156	2704059	167373	5354347	31328452	35091
155.60	1556	2678142	484197	3762754	77356	1665190	30940244	9621
156.48	1565	2428485	617980	4076683	59850	271116	31280634	5327
157.36	1574	2404198	546355	4143613	85280	84545	30765798	4142
158.24	1582	2361567	589766	3895054	136439	2152112	30728188	3699
159.12	1591	2594167	545233	3436351	159388	821929	31027374	5031
160.00	1600	2860716	414409	2581622	124315	4467582	34967080	9029
160.88	1609	2505928	401340	3741208	68603	5938333	36803592	7401
161.76	1618	1459216	454802	4761808	115209	4175246	37080288	32424
162.63	1626	1993749	364140	2488410	143950	5939656	32803784	31833
163.51	1635	1985752	294530	2280521	99712	6055159	32335444	29463
164.39	1644	1730921	456695	4580037	102493	3560170	30662604	22355
165.27	1653	1592485	356098	3100888	371001	4772274	30367576	17617
166.15	1661	10522858	380699	2994079	133896	4257013	30554118	44269
167.03	1670	23212980	360001	1503099	68132	3903984	30437128	122897
167.91	1679	5130760	87587	229058	14605	1056622	29903202	19246
168.79	1688	461829	15374	61447	5440	133704	29651454	5770
169.66	1697	149402	5853	34596	4375	46788	29617244	3697
170.54	1705	47823	3841	29627	4018	26649	29621970	3107

171.42	1714	24577	3545	26906	4315	23539	29652400	3846
172.30	1723	22947	3545	26552	4670	20579	29646162	3256
173.18	1732	21022	3308	25664	4195	18803	29610630	3846
174.06	1741	18950	3071	25428	4019	19839	29629152	3253
174.93	1749	17172	3367	24955	4374	19987	29571884	3697
175.81	1758	18209	3485	25013	4374	19246	29642760	3848
176.69	1767	18803	3427	24895	4255	19099	29546370	3254
177.57	1776	17617	3308	25487	4196	18803	29570752	3253
178.45	1784	17617	3248	24955	4136	19987	29506680	3401
179.33	1793	18061	3367	24659	4077	18804	29510648	2958
180.21	1802	17766	3012	24660	4255	18803	29512160	3107
181.09	1811	18210	3308	24540	4195	19395	29516696	3551
181.96	1820	17026	3426	24955	4315	19395	29566026	3848
182.84	1828	17468	3189	25190	4552	18358	29462076	3254
183.72	1837	17766	3248	25192	3960	19247	29469068	3699
184.60	1846	17617	3367	24363	4255	19541	29542024	3996
185.48	1855	18506	3308	24718	3841	18803	29482300	4142
186.36	1864	17469	3248	24836	4136	19691	29477764	3254
187.24	1872	18060	3426	24895	4316	18506	29531816	3700
188.12	1881	17617	3367	24895	4315	19838	29542780	3551
188.99	1890	18060	3485	25310	4075	18950	29526336	3254
189.87	1899	17766	3367	24837	4198	18358	29527848	2959
190.75	1908	17469	2953	24009	4254	19690	29523690	3402
191.63	1916	18506	3308	24837	4077	18803	29458484	3403
192.51	1925	18061	3426	25014	4018	18358	29438828	2958
193.39	1934	17469	3189	25249	4078	18209	29482866	3254
194.27	1943	18653	3071	25131	4018	18950	29478708	3551
195.15	1951	17026	3248	24186	4195	18358	29412368	3107
196.02	1960	17617	3130	23951	3900	19099	29400462	3550
196.90	1969	17320	3189	25133	4257	18357	29417094	3996
197.78	1978	17766	3485	24422	4136	19246	29455650	3697
198.66	1987	17914	3248	25311	4433	18949	29379104	2808
199.54	1995	17763	3485	24895	4492	17765	29429380	3699
200.42	2004	17468	3130	24245	4374	19247	29316546	3699
201.30	2013	17914	3189	25074	4075	17912	29370222	3551
202.18	2022	17174	3308	24896	4196	19098	29453572	3253

Table 13: Carbonate traverse down 90 raw data major elements

traverse minor down 90 um											
Ave blank		**43,589**	**24,657**	**26,068**	**25,997**	**110,620**	**622**	**837**	**57**	**558**	**-**
Trace for Mass:	Distance (um)	Mn55(LR)	Ni58(LR)	Zn64(LR)	Rb85(LR)	Sr88(LR)	Mo98(LR	La139(LR	Ce140(LR)	Th232(LR	U238(LR)
Resolution:		Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Time	10	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity	Intensity
[sec]	um/s	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]	[cps]

0.90200001	9	52262	28684	27982	26677	121409	400	1100	100	600	0
1.728000045	17	45539	24771	25173	31192	110152	700	1101	100	801	0
2.553999901	26	43531	22966	28583	24671	115485	1000	801	0	901	0
3.378999949	34	46041	22866	28384	25072	117853	1001	501	100	300	0
4.204999924	42	46844	26277	24570	25474	113122	701	800	0	1101	0
5.031000137	50	43932	23266	30089	25674	113111	600	1201	200	500	0
5.856999874	59	47745	26276	23669	24872	108970	500	901	100	400	0
6.683000088	67	39317	25574	25575	27179	113117	300	600	100	600	0
7.508999825	75	41224	24772	24068	25775	114304	500	700	0	300	0
8.335000038	83	43631	26175	27079	27881	109561	300	300	0	802	0
9.161000252	92	41825	21762	23667	29186	109561	902	901	0	500	0
9.987000465	100	44936	24770	27479	28182	111333	400	1001	0	400	0
10.81299973	108	44134	25674	26076	23868	106011	500	1001	0	300	0
11.63899994	116	43933	25373	25674	26577	108970	1201	1202	100	300	0
12.46500015	125	41525	23969	26276	24370	104824	601	1402	100	600	0
13.29100037	133	41825	23969	26074	26577	111935	601	701	100	1001	0
14.11699963	141	43331	24471	26276	23266	106011	601	500	0	701	0
14.94299984	149	42428	22464	25172	25574	109561	601	1002	200	701	0
15.76799965	158	43431	22465	23568	23969	105415	801	700	200	400	100
16.59399986	166	42729	25473	24270	25775	105415	701	1301	100	901	0
17.42000008	174	42929	25774	25173	25875	107789	500	400	0	701	0
18.24600029	182	42930	24370	26577	26077	104824	801	1101	0	800	0
19.0720005	191	46442	22865	28383	28283	106602	501	500	0	600	0
19.89800072	199	41324	25272	23668	23065	100672	800	600	0	1001	0
20.72400093	207	45539	27781	24270	26578	106005	801	900	100	1000	0
21.54999924	215	44234	25072	26778	64910	783582	1201	20660	80266	6015	10931
22.37599945	224	438020	97331	54771	241459	7122950	601	41224	212879	12033	9927
23.20199966	232	495324	78356	43732	268695	8424533	500	41324	151065	12033	4210
24.02799988	240	572524	64004	44134	131675	12372743	901	37211	174782	6818	2004
24.85400009	249	496836	44134	41525	151566	13586170	500	32295	126753	6416	600
25.68000031	257	354074	37111	35305	68319	13096472	501	19755	79962	1704	400
26.50600052	265	231080	30189	37010	39919	12525455	800	14641	49753	801	100
27.33200073	273	329294	41725	35506	38918	12632618	801	16144	57279	1202	500
28.15800095	282	597796	76750	49051	104359	11319635	700	16546	78558	4311	6517
28.9829998	290	487742	182020	75144	324976	6769740	1302	128763	428860	72235	197703
29.80900002	298	402334	191161	62398	401132	2402273	1201	59386	172076	87995	160509
30.63500023	306	248982	119924	48750	346014	1063728	1704	33801	77353	16446	30591
31.46100044	315	376534	129163	171868	452778	3280024	1001	30093	108684	14540	21562
32.28699875	323	521948	114400	74447	353280	4362687	1001	30590	130881	17650	33211
33.11299896	331	719264	120526	67015	378048	4496570	1502	39318	145641	10828	40833
33.93899918	339	450944	133486	61996	325066	3189411	1804	25875	98536	14340	28583
34.76499939	348	495160	191768	195571	367976	400191	2003	29085	98433	12735	14540
35.5909996	356	606970	109783	68619	296476	3665017	1303	65910	185736	9425	9927
36.41699982	364	419262	89200	67516	324276	7399917	1001	75850	187242	11631	10126
37.24300003	372	470294	125750	276201	335448	1379340	1302	50655	122538	24977	7920
38.06900024	381	586454	116008	71530	294073	7733313	700	41225	122837	7921	8422
38.89500046	389	648840	182018	72634	373562	7640836	2105	30088	103857	7319	6918
39.72100067	397	1300360	209177	78756	209161	6252097	1001	42227	122736	10729	6215
40.54700089	405	1117533	163021	75847	180307	8148546	1301	35605	109480	6616	5915
41.3730011	414	977600	140115	64403	193877	5539590	701	74168	134101	8724	5313
42.19800186	422	1593344	627388	81468	222733	3589552	1603	26677	252926	10429	14742
43.02399826	430	982780	717060	76649	372416	4772163	1603	27983	105266	18652	34401
43.84999847	438	647184	183726	85383	495954	2742248	800	33800	138107	29586	42227
44.67599869	447	525496	160711	74444	485746	3118358	1001	23568	77354	10429	10027
45.5019989	455	532750	181730	55071	325474	4728166	1102	44035	104058	12234	11231
46.32799911	463	733896	125651	59687	288025	5554403	2003	38517	98837	23668	33801
47.15399933	472	413444	107873	54470	266586	3854537	2304	28683	64706	8121	13737
47.97999954	480	374620	139216	51259	308967	2077122	1101	28483	70627	12233	14139
48.80599976	488	569242	380482	252841	346114	677832	1803	46040	134890	16044	15243
49.63199997	496	536398	162217	52663	391864	2360823	2103	34202	192431	15342	22264
50.45800018	505	563034	115907	44335	306746	5861516	1201	57280	203859	11030	11330
51.2840004	513	625500	102954	40722	294090	4888060	2104	66116	141627	13438	11933
52.11000061	521	586846	139410	42628	343704	5029609	2404	35707	122152	12032	14942
52.93600082	529	621410	136398	42829	320645	5268883	902	40422	152180	10529	8121
53.76200104	538	793756	210674	51759	358200	4387688	8622	50355	260476	18752	14339
54.58800125	546	905052	325164	123943	264980	2061160	4812	35906	161720	11331	13939
55.4129982	554	490786	160711	50154	314996	3669152	1301	48951	131979	14941	10327
56.23899841	562	412330	173876	62598	355378	2072373	1703	25172	97128	8121	10930
57.06499863	571	676094	242144	54469	338058	4585506	1803	21461	90008	7319	8924
57.89099884	579	524896	178503	41926	187041	5878940	2505	23167	75747	6817	7219
58.71699905	587	542342	195104	43130	195586	7852997	2103	123520	149567	12635	14741
59.54299927	595	620938	216399	50354	281580	3341858	3107	84613	127157	17148	17047
60.36899948	604	608816	238623	56075	505046	5086836	1704	108217	105063	15443	17850

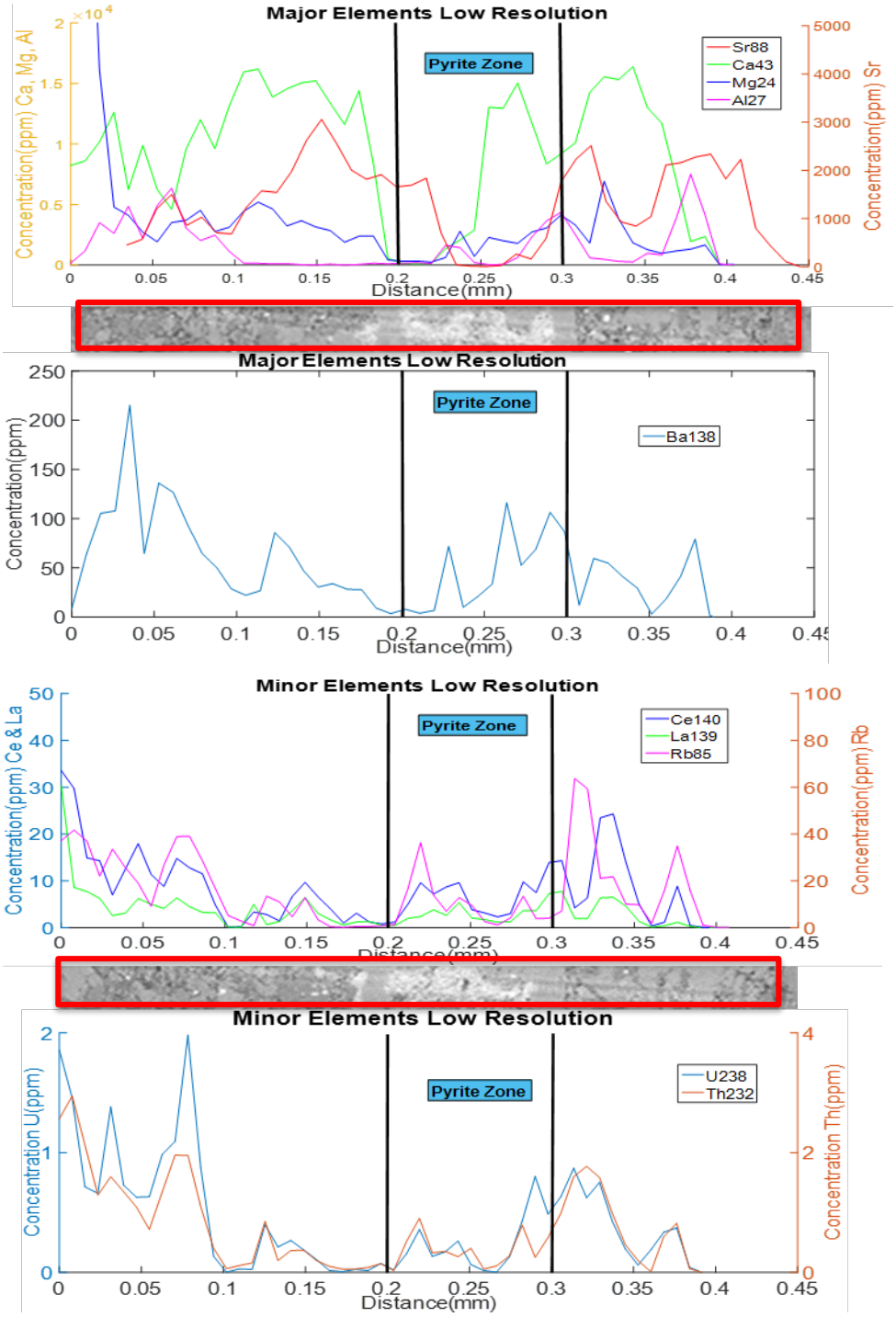
61.19499969	612	1590904	370694	53967	468628	3155359	2606	16044	55775	8623	8924
62.02099991	620	2121744	308356	48147	243653	2884700	1002	24475	44534	5012	5112
62.84700012	628	1491256	231089	51760	281998	1929283	500	10929	40724	7518	9926
63.67300034	637	603646	114501	65920	271818	1174482	800	9025	26677	4510	14841
64.49900055	645	348350	132580	44334	279570	1567743	2305	11030	46246	5815	19460
65.32499695	653	452190	128462	38816	294864	1944444	1202	19253	90113	7118	5112
66.15100098	662	1163580	404164	63401	291138	3797667	2305	53577	58683	4711	5013
66.97699738	670	2356336	437226	62798	321654	5114596	2204	26181	54268	4311	11130
67.8030014	678	3469744	367572	44836	238703	2833465	700	15341	45437	6417	9125
68.62799835	686	4821792	365564	42127	138307	2591793	802	30489	67717	5314	4310
69.45400238	695	2319440	248480	50154	236109	4008004	1703	34202	99037	13337	11030
70.27999878	703	740120	173778	51961	271117	2905119	1101	21863	69825	8924	6617
71.10600281	711	666204	293858	66915	293358	2824979	1502	43031	144339	12634	6316
71.93199921	719	590964	174677	121057	220418	2100818	1703	13136	55574	4610	8021
72.75800323	728	963672	193071	75444	291242	3533340	1201	21862	106897	7219	11331
73.58399963	736	730676	147749	69524	292850	3246867	1603	42637	115207	7219	5715
74.41000366	744	808748	145842	144693	238624	5929875	1604	39620	107171	10228	6617
75.23600006	752	894328	190461	114501	137502	11188706	8121	24570	58584	6115	4110
76.06199646	761	1463056	471198	2862576	283698	9349473	5613	31191	111198	13236	8523
76.88800049	769	791252	286817	5102048	304228	3687364	5013	53568	141524	31292	41126
77.71399689	777	703846	384624	1776768	296498	3745130	3608	33901	74341	20359	14139
78.54000092	785	985216	606592	601228	247072	5109779	4911	33097	102663	9525	6216
79.36599731	794	2557552	1543336	269911	354058	7934520	9926	27982	74843	11231	14942
80.19200134	802	3567072	2262560	204532	246166	8074574	13638	26076	73037	9125	43355
81.01799774	810	4812387	1228472	131675	228468	9287507	7720	96417	114104	13236	11532
81.84300232	818	2195880	627724	87392	250290	5692750	2204	50154	146449	14941	9425
82.66899872	827	955992	233797	63903	227056	4603193	1101	41927	112493	14539	10829
83.49500275	835	822736	249793	56778	348438	5616310	1603	45739	152485	13938	10829
84.32099915	843	602536	146946	91670	356894	3733695	1202	50963	100141	15844	19555
85.14700317	851	490808	116609	40924	272935	3054984	2003	35807	116209	10428	8924
85.97299957	860	354482	78959	41826	213480	2412940	400	23066	61093	5615	4912
86.7990036	868	707600	136202	36911	189252	2782517	1001	15744	54672	4209	2605
87.625	876	2218080	204735	35204	122335	2418869	801	16446	51359	2606	2405
88.4509964	885	2639840	257133	63309	177200	2756447	1603	19956	65915	6316	6116
89.27700043	893	1236632	227060	155501	224947	9197340	701	24370	79061	7921	7119
90.10299683	901	776136	221548	42227	172877	10137960	2105	28783	101447	7418	8622
90.92900085	909	848388	142932	40923	195786	7442584	1501	46341	163325	15643	15042
91.75499725	918	861548	180105	42328	331328	4629248	1101	53366	151469	12734	15242
92.58100128	926	595880	167648	51458	237314	6104269	1502	71128	257078	11632	9124
93.40699768	934	890356	247879	53466	231887	7614445	1402	34000	109581	11029	6116
94.23300171	942	939440	170959	49755	275863	6295921	1101	29485	76750	11331	11230
95.05799866	951	676432	270611	51459	277359	4859152	1502	38816	134493	11130	8723
95.88400269	959	700180	185837	51861	291746	4071320	1101	33901	103858	13236	16546
96.70999908	967	598008	128060	49754	243551	5804332	1402	38715	120028	13436	33199
97.53600311	975	805688	106871	45839	260048	6582587	1000	49855	120427	10728	14441
98.36199951	984	1577856	161514	54670	217506	4077793	1301	63332	88798	5413	5613
99.18800354	992	3716896	334959	48749	136898	2932961	700	20457	47545	1703	2605
100.0139999	1000	4162048	420478	39518	116710	3660871	1402	20257	71433	2706	901
100.8399963	1008	3080752	292042	48047	261463	3019774	1602	16847	49050	19355	36007
101.6660004	1017	1938280	271520	48048	261052	5854494	701	20358	59989	7219	8221
102.4919968	1025	987128	136397	41625	266090	6061372	901	18451	59086	4009	6617
103.3180008	1033	607708	85082	43330	217805	5755759	701	17549	52262	12936	12635
104.1439972	1041	359708	65408	100500	171565	3371843	1101	11029	43133	8422	10327
104.9700012	1050	537500	126956	277916	125548	6172717	1502	27380	93516	7318	33208
105.7959976	1058	690284	275440	60792	211786	5515304	1102	22464	125753	25172	44836
106.6220016	1066	511554	122434	45437	315702	3562532	1100	19154	45338	8824	10327
107.4469986	1074	987952	173473	45939	227862	2059344	901	55580	118923	4811	5613
108.2730026	1083	2142720	218409	136561	108977	6756679	801	44434	142435	3407	1502
109.098999	1091	1948336	150060	51358	73139	15887812	500	40421	92410	2504	2706
109.9250031	1099	1069688	171767	52764	139109	12569303	1100	34503	98747	5614	5514
110.7509995	1108	646544	123742	164363	227560	5169386	1402	26075	63903	5815	5513
111.5770035	1116	785368	110586	43531	135193	4366845	1803	21462	68821	5312	5112
112.4029999	1124	1042196	121733	39920	171473	5079966	3307	28182	88097	4210	3909
113.2289963	1132	1905608	500090	44735	159608	5864150	12433	18150	39819	5314	7921
114.0550003	1141	2467776	849096	47546	125448	8877046	18552	28584	76750	2705	3508
114.8809967	1149	1139856	331190	44937	89599	12711998	10429	27179	65006	4611	4611
115.7070007	1157	436016	94823	27982	37312	2883798	3007	5313	10829	801	200
116.5329971	1165	74742	27280	27078	25473	354765	500	1302	1502	400	100
117.3590012	1174	50255	27380	28884	24570	419326	400	801	500	801	0
118.1849976	1182	44636	24269	24972	23969	120812	600	1302	400	1001	0
119.0110016	1190	44434	27079	22665	24270	104824	300	600	200	501	100
119.836998	1198	48548	23767	23468	26276	109561	500	400	0	801	0
120.6620026	1207	41826	25072	27379	24873	100087	300	901	400	601	0

121.487999	1215	42930	20058	25875	25072	97122	300	701	0	0	0
122.314003	1223	42728	25875	25072	20558	95345	600	601	0	600	0
123.1399994	1231	43631	23768	26777	24772	95345	400	501	0	601	0
123.9660034	1240	43732	22464	24672	22263	94157	701	800	100	900	0
124.7919998	1248	40521	21863	25072	22464	98310	300	601	0	400	0
125.6179962	1256	38515	23266	26677	26878	90608	700	802	100	1302	0
126.4440002	1264	42830	27580	27380	23969	92976	400	700	0	400	0
127.2699966	1273	43230	25674	25173	24871	91198	700	701	200	1101	0
128.095993	1281	40020	23065	26777	25674	95345	1101	801	100	200	0
128.9219971	1289	42929	24370	26276	25474	97122	601	1202	0	400	0
129.7480011	1297	39217	23166	21962	24972	91795	700	300	0	500	0
130.5740051	1306	39618	20357	26778	22464	99491	701	801	0	601	0
131.3999939	1314	41425	25173	25474	24973	96532	700	601	200	901	0
132.2259979	1322	41325	21362	26979	22163	94754	400	501	0	1302	0
133.052002	1331	46641	24470	26074	22163	93567	600	701	0	801	0
133.8769989	1339	43330	25574	24470	24470	91204	1302	700	0	701	0
134.7030029	1347	36910	22866	25673	24069	93573	701	901	100	500	0
135.529007	1355	41123	24068	25473	21561	92970	300	1002	100	300	0
136.3549957	1364	41926	25071	26176	23767	96532	400	1001	0	1001	0
137.1809998	1372	42930	26076	23567	24170	95351	500	1102	200	500	0
138.0070038	1380	41926	26177	24570	23869	93567	1502	700	100	600	0
138.8329926	1388	40923	24271	27179	24772	92386	501	700	0	200	0
139.6589966	1397	46944	23366	21361	24571	93573	900	1000	0	501	0
140.4850006	1405	42127	26678	25072	24170	97122	400	1202	0	400	0
141.3110046	1413	37712	24269	24872	25674	94163	200	700	100	900	0
142.1369934	1421	42528	23468	22163	23968	99491	100	1101	0	200	0
142.9629974	1430	39618	24871	25774	21260	93567	1302	801	100	500	0
143.7890015	1438	46842	27178	24271	23468	96526	200	1000	0	400	0
144.6150055	1446	40922	24470	26578	23968	95345	700	1100	0	400	0
145.4409943	1454	43431	25874	26076	24270	95345	801	800	0	700	0
146.2669983	1463	40622	22765	21159	22665	94748	500	700	100	1302	0
147.0919952	1471	38615	24469	23969	23568	94169	400	1202	0	500	0
147.9179993	1479	38314	23367	27580	22664	95345	801	300	100	200	0
148.7440033	1487	38415	21763	24671	20859	92970	701	400	100	401	0
149.5700073	1496	40120	25573	24070	22263	96532	200	800	100	1102	0
150.3959961	1504	34301	25373	24370	23367	97122	701	900	0	500	0
151.2220001	1512	44033	24972	25274	24572	96526	800	700	0	600	0
152.0480042	1520	41825	23869	26075	24670	88830	701	901	0	800	0
152.8739929	1529	38114	24871	23367	21762	94163	800	701	0	100	0
153.6999969	1537	37812	21962	24671	23767	94754	700	1301	0	500	0
154.526001	1545	40622	26276	27781	23768	92976	300	200	0	500	0
155.352005	1554	41926	23367	25574	21261	94748	700	1102	0	200	0
156.1779938	1562	41826	21461	24170	26477	92386	901	1101	0	501	0
157.0039978	1570	39819	25073	25674	24872	97122	700	700	0	901	0
157.8300018	1578	42528	21261	24771	26576	93573	400	900	300	801	0
158.6560059	1587	39719	24471	23869	21161	96532	100	1102	0	1102	0
159.4819946	1595	41324	21060	25072	25373	95935	801	1101	100	400	0
160.3070068	1603	42427	25774	29084	22764	90017	1001	901	0	601	0
161.1329956	1611	40421	23668	25674	21963	94754	801	700	0	800	0
161.9589996	1620	43029	26376	25574	22866	92380	400	800	0	801	100
162.7850037	1628	43030	21861	24571	24170	97713	600	500	0	500	0
163.6109924	1636	45037	26578	24170	24270	90011	501	701	100	800	0
164.4369965	1644	40723	24671	27982	21762	95935	400	1302	0	700	0
165.2630005	1653	40923	23367	25775	24471	91789	500	901	0	600	0

Table 14: Carbonate traverse down 90 raw data minor elements

Laser Ablation Graphs

Site E



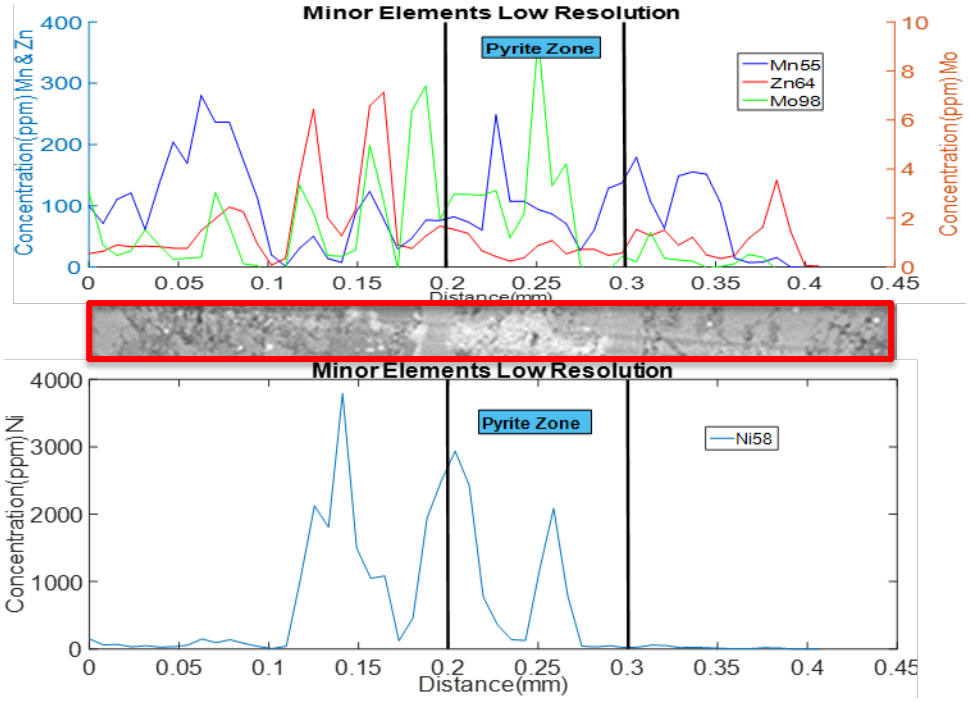


Figure 9: **Laser ablation results site E**